VOLUME 1

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Intellectual Property and the New Computer-based Media

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> "There are men that will make you books, and turn 'em loose into the world, with as much dispatch as they would do a dish of fritters." (Cervantes, Don Quixote [1])

I. **Introduction.**

The stored-program digital computer has changed the basic concept of what intellectual property is about. The digital computer permits an ease of storage, retrieval, manipulation and transmission of information using techniques completely at odds with our notions of copyrights based on 400 years of the printing press. [2]

While other technologies have made it more difficult to protect intellectual property rights, the combination of the digital computer and the growth of telecommunications networks poses a unique dilemma to existing laws and concepts. This arises not so much from the ease of digital copying, the automaton in the machine, nor from its recursive qualities; the problem lies in scale, speed, and the power of network technology.

For this paper, we will narrow the definition of intellectual property to works whose output can be stored in tangible media, and which can be transmitted across space and time to be useful to others. The concern is primarily with how modern electronics, based on microprocessers, has changed the locus of creation, publishing, and distribution of such property. The actual means of distribution -- whether by satellite, fiber optics, or hand-carried tapes and disks -- and the generic device which presents the creative work to people (or other machines), are less interesting than the fact that universal, general-purpose, programmable, logic machines are engaged in the process: that the system now exhibits some level of intelligence, and that it may be capable of robotic decisions on its own in the near future. Property rights never before had to consider the role of networked automatons working at the speed of light.

The computer

Today, digital computers can store, manipulate, and transmit such intellectual outputs as writings, instructions, abstract numerical data, and graphics including highly detailed motion pictures. Machine conversion of data from one form to another is automatic and inherent -- from tables of numbers to multi-color, three-dimensional graphics, for example; even machine translation of language is conceivable [3]. Also, the machines' programs can now create intellectual property on their own, for example generating formulae for new chemical compounds [4].

The machine is at once a series of processes, concepts, and syntheses of human intelligence -- so mixed that it is difficult, if not impossible, to separate its parts from the whole. Further, a stored-program digital machine is recursive in that it can change its own instructions, sometimes unpredictably (even unto itself), and it has the ability to be self-learning (though this feature is just at its earliest stages).

Since the workings of digital computers and of telecommunications are merging, a worldwide, cost-effective, interconnected, and very rapid set of digital networks will permit the instantaneous transfer and processing of any form of human and machine intelligence to any part of the globe. Property rights which formally took into consideration a fixed location where the property was "printed," "published," "stored," or even "created" has no meaning within such a system. Even today on information retrieval networks, we can observe vast amounts of proprietary information jump from one point to another -- and vanish -- at the speed of light; storage is in various and sundry locations often depending on machine logic; and publication may be at numerous simultaneous points, with each publication quite different from the next. The ability of machines to create is but the next step, and has been demonstrated in experimental situations.

Artificial barriers to network transfers of information are typically ineffective, if not impossible. Within this system, the laws of geometric increase have a profound effect, in that it is simple to make multiple copies of any form of data quickly, for copying and moving data are precisely how the digital machines do their computational tricks.

I.A The locus of control is the key to copyright.

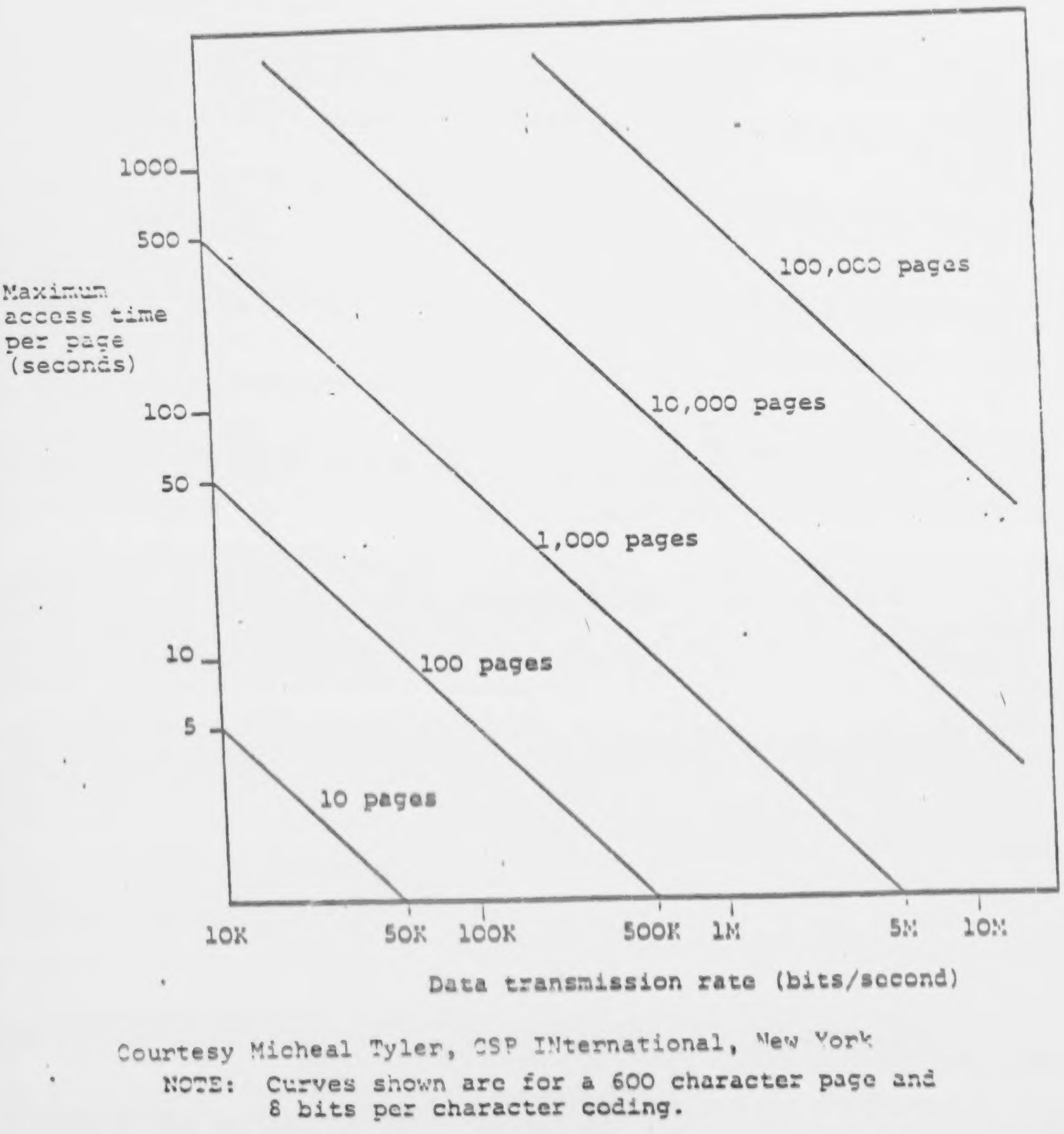
The concept of copyright is rooted in the technology of print [5]. It predates the concept of intellectual rights protected by patent, such as inventions. Further, copyright is much more directly related to the problems created by the new digital technologies.

The recognition that there could be a property right in text and the practice of paying royalties ("payments to the Crown" for the privilege of publishing via print) emerged when the printing press reached a stage of development where it threatened the sovereign's hegemony. King Philip and Queen Mary of Britain, in 1557, in an effort to stop seditious and heretical ideas from being transmitted within their realm limited the right of printing to members of the Stationers' Company. The Company was given the right to search for and seize anything printed contrary to statute or proclamation; draconian measures were prescribed for violators and resistors [6]. Eight years later, the Company created a system of copy rights for their members.

Because numerous copies were made in one place, it was feasible to identify the source of the copies and the number actually made. The printing plant appeared to be the practical point at which to apply control of information flow. However, even then, as one author has noted, "the increasing number of works made it impossible to acknowledge every sermon, almanac and ballad." [7] For modes of reproduction where such an easy locus of control did not exist, the concept of copyright was not applied under common law. Until quite recently it was not applied to conversation, speeches, or singing of songs, whether in private or public. Copyright, as we know it, remained a specific protection applied to a specific technology; though in the free, Western nations, it is rarely used for censorship, but instead to protect fiduciary and other rights of authors and publishers.

I.B Role of printing in intellectual property.

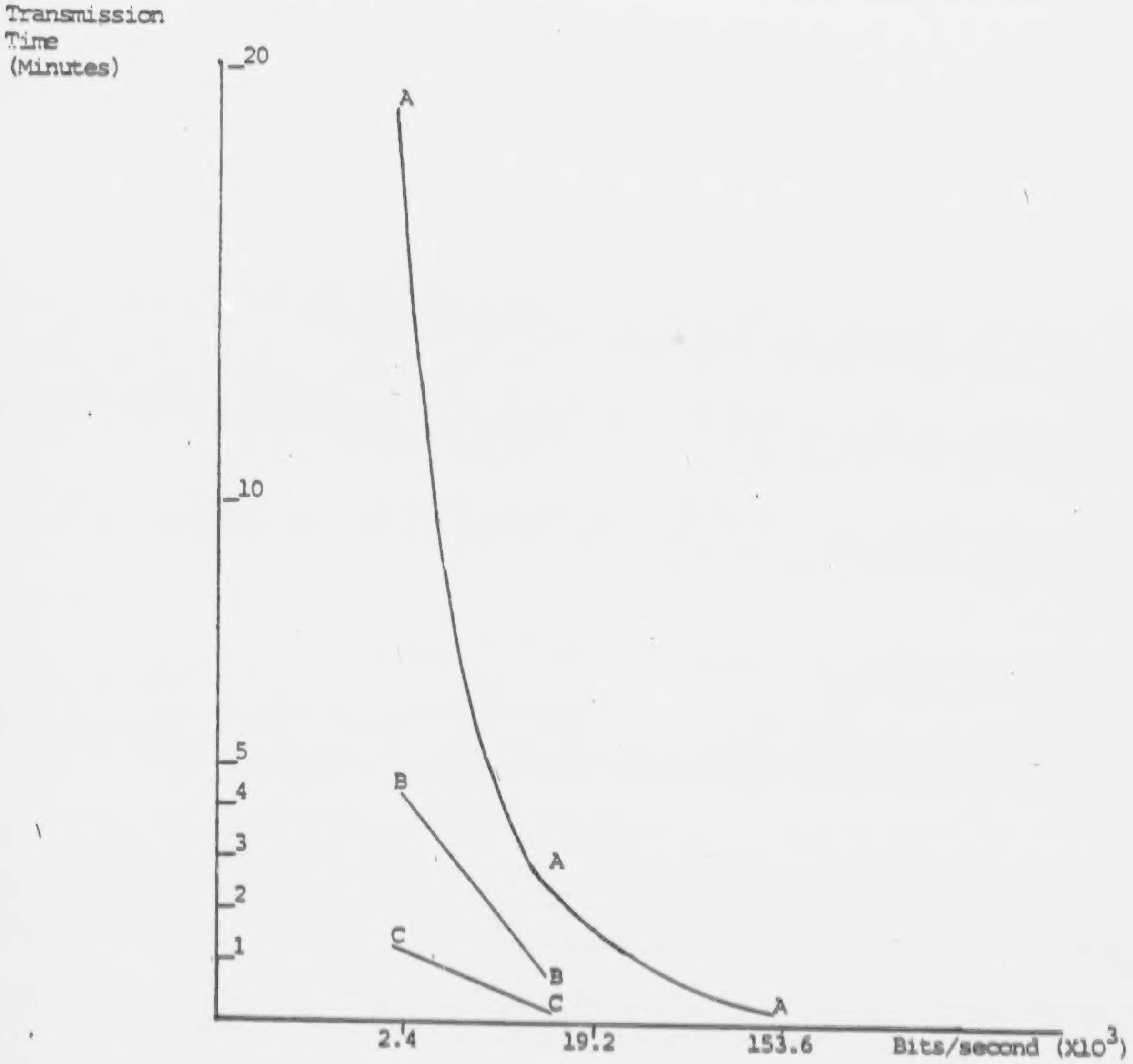
The technological underpinning of copyright rested with the actual mechanism of printing impressions on a medium (paper, FIGURE __ RELATIONSHIP BETWEEN INFORMATION BASE SIZE, DATA TRANSMISSION RATE AND MAXIMUM ACCESS TIME PER PAGE FOR ONE-WAY SYSTEMS (TELETEXT)



Courtesy Micheal Tyler, CSP INternational, New York

NOTE: Curves shown are for a 600 character page and 8 bits per character coding.

FIGURE . RELATIONSHIP BETWEEN TRANSMISSION TIME AND TRANSMISSION RATE FOR PHOTOGRAPHIC VIDEOTEX SYSTEMS



A	Full Frame, no compression
B	Full Frame, 4X compression ¼ Frame, no compression
C	¼ Frame, 4X compression

Courtesy Micheal Tyler, Communications and Planning, New York disks, metal cans, etc.). This required, until fairly recently, a heavy capital investment in specialized machinery. Fakes were rarely cost-effective for small runs because of economies of scale. Typesetting equipment and presses were difficult to conceal. Paper was normally ordered and stored in large quantities (the control of paper supply is still used by many governments, including some democracies, as a moderate control on the press). Even the supply of specialized labor -- writers, editors, pressman, artists -- has been a constraint on publication.

Early on, technologic evolution strained the law for protection of copyrights. [8]. First came cheaper presses, then photography and lithography, machine typesetting and the steam-driven press, phonographs, mimeographs, motion pictures, television, xerography, broadband coaxial cable and satellite networks. Each changed the loci and costs of production and distribution, making infringements harder to police. The highspeed copying machine, the automatic videocassette recorder-timer, and broadcasting in general, best illustrate why principles which were meant to cover centralized printed publications could not simply be extended to everchanging decentralized media.

A Procrustean solution cannot fit all technologies. A clear example of how printing is being changed by networks (even if the computer had never entered this picture): Document transmission is moving to remote, on-the-spot printers -- such as inexpensive, computer-controlled, laser-scan xerographic devices. These are connected to highspeed data transmission networks, moving the loci of "publication" from producer to user. If the ubiquitous loci of "publication" from producer to user. If the ubiquitous photocopier has made copyright restrictions difficult to control and enforce, remote laser printing is an order of magnitude more powerful; these machines can store, manipulate, transmit and automatically reproduce perfect copies at the touch of a button. Manual labor input will have finally vanished from the replication process.

A corollary of remote printing is the inherent process control properties brought by the digital computer. Top-quality publishing will be able to be decentralized -- from typesetting to impression. The specialized skills once needed to get something into publication are being eliminated. Furthermore, applications of artificial intelligence or "expert systems" programming will accelerate this phenomenom. Almost anyone who has something to write (or say) will be able to be an author-publisher with access to the universal network.

What this means for quality of product, or information overload to the potential recipient, is another question. But universal printing will affect the economics of publishing, and will therefore bear on the future effect of interest groups concerned with property rights.

I.C Role of non-print media.

While movable-type printing has always been "digital" -- which means nothing more than the manipulation of discrete symbols (such as the letters of an alphabet) [9] -- sound and pictures have used media which tend to be continuous, "analogs" of reality. Analog storage and transmission is more tolerant of space or transmission "bandwidth". However, digital information can be reproduced precisely as in the original, while analog information readily loses fidelity due to noisy transmission paths and less than perfect storage media.

Once something is digitized, sound or pictures, it is an easy small step to make perfect, perhaps even enhanced copies. The computer can break up a sound wave, or a picture, into discrete binary-encoded parts which perfectly represent the original, at least to a human observer [10]. For audio, it is becoming cost-competitive to digitize sound for recordings and for transmission, rather than to store and re-transmit an analog version with all of its distortions. (For telephone calls, digital speech transmission is pervasive throughout the network.)

Graphics, drawings, etc., are close to the time where digitization and computer-storage may make economic sense. Highspeed, high-resolution facsimile devices are competitive with express mail in long-distance transmission. [11] There is little difference between digital facsimiles and laser text printers (most are both). Full-motion digital video, however, is more complex to achieve. While hybrid analog/digital video has reached the consumer market (and has been used for editing for several years), totally digital television is probably a long way off [12].

I.D Intangible Media: electronic communications.

We have usually considered property rights where there is some tangible property which can be identified. Even within a computer, the bits are in some tangible form, if volatile and computer, the bits are in some tangible form, if volatile and elusive. Binary numbers are impressed in tiny north and south magnetic poles on disks or tape. Within a computer's working or core memory the bits may alter the state of the semiconductor for a millionth or billionth of a second, but they are altered and there is a way to read that state. In so-called ROMs (read-only memories), the semiconductor is semi-permanently altered, and can always be read. But, transmission systems can be defined as containing intangible information for several reasons:

1) Electrons, electromagnetic waves, or photons are transient (for our purposes these can be considered the same phenomena); they disappear when their energy stimulus is turned off [13]. On a high-speed telecommunications circuit they appear and disappear as rapidly as 10 billion times each second;

2) Without a receiving device of some kind, the transmission is for all practical purposes, non-existent;

3) Unlike physical media (disks, tapes, film), wire or ether transmission does not lend itself to physical controls (such as a locked box).

This suggests that methods of control for intangible media would be akin to encryption or scrambling, whereby information is transmitted in such a way that only specialized receiving devices can gain meaning from it. In the earlier days of centralized automatic data processing, identifying property protected by copyright was not impossible -- the property, existed in a place where it could be found, though it might be extremely difficult to ascertain. But with networks, useful information passes out of the sphere of influence of the originator. (One possible, but limited method of maintaining control is with closed networks; this scenario is explored in later sections.)

I .E A proposed taxonomy of major technologies: costs and effects of storage, transmission, and replication.

Figure one indicates how five basic types of intellectual property may be stored, transmitted and replicated for use or re-use. Since we are concerned with copying, the relative total costs of reproduction are roughly estimated for the present and the near-term future (based on known technology). The controlling variables are the transmission and reproduction processes, shown in columns 3 and 4.

No predictions are hazarded for the long-term future. Clearly, the trends for all the major technologies shown are toward lower total costs for replication in the near-term, though for those requiring large labor inputs (copying of books and microfilm, for example), the downward trend is not as great as for physical items which lend themselves to easy automation (unbound sheafs of paper, machine readable data on disks, etc.)

There are many other possible combinations omitted from the chart. Only those technologies which are expected to have a major impact on intellectual property in the near future have been emphasized.

One omitted example is microfilm. Twenty years ago, it was thought by most practioners that microfilm plus xerography had the economic potential to replace the book in technical libraries. Computer memories were too expensive to compete with print, then; but this has changed dramatically. Or perhaps the copyright infringement issues were a much clearer threat with film, so it simply never gained much of a publishing market share. [14]

The chart should be read from left to right -- it is not a matrix as such, but a nested list. On the left are five basic types of intellectual property:

1) Paper: text, text plus mathematical formulae, text plus graphs -- all requiring some sort of typesetting, originally. For this group transmission is by hard copy, and two types of replication, photocopy and re-setting of type is postulated. The results for total costs of replication are then shown in the next column;

2) Machine-readable text, including graphs and formula. Alternately two types of distribution are listed, one on storage media (disk, tape) which would be transported, and the other via a telecommunications link. Replication would be by computer;

3) Audio is shown for two variations, analog disk or tape, and digital mass storage. Other possibilities could be digital audio switched via packet or circuit networks, and broadcast audio;

4) The variations shown for moving images range from videotape and videodisk (which today have radically different replication modes) to conventional release motion picture prints (typically "bicycled" or shipped from theater to theater), and a hypothetical high-definition theater release hybrid using combined film and tape technologies. VCRs, with the introduction of mini-cassette formats, may drop precipitously in price in the near future. Other possibilities include switched video, and digitized video, but the cost inputs of these yet-to-emerge technologies are currently unknown [15];

5) Computer programs and artificial intelligence are a novel form of intellectual property, for they can be replicated not only by direct copying of the instruction code (similar to machine-readable text) but have the potential of being replicated by using the computer's inherent properties to imitate any "black box" by knowing only its outputs. Both types are shown.

The column on the Future Migrations of replication technology shows the tendencies to merge with some other technology, blurring the future lines between reproduction devices. The integrated optical-scanning, laser-printing, and facsimile machine is a current example, which can also provide

Figure One.

A TAXONOMY OF MAJOR TECHNOLOGIES FOR REPRODUCING INTELLECTUAL PROPERTY:
Effects of storage and transmission on total costs of replication.

Types of Property	Storage Media	Transmission or Distribution	Replication Techniques	COSTS OF REPLICATION		Future Migration
				Today	Nearterm	
A. PRINTED TEXTUAL MATERIAL						
alpha-numeric text	print on paper	mail, parcel, etc.	xerographic	HIGH	LOWER	on-demand printing
	bound book	"	"	VERY HIGH	LOWER	"
	microfilm	"	"	HIGH	LOWER	"
	printed material-alpha	"	re-set type	VERY HIGH	MUCH LOWER	optical scan; digital store
alpha + formulae	paper	"	"	HIGHEST	MUCH LOWER	"
+ graphs	"	"	"	"	"	"
B. MACHINE-READABLE TEXTUAL MATERIALS						
text	machine readable	mail, parcel of media: disks, tapes, ROMs	computer copy to printer, VDT, etc.	MEDIUM	VERY LOW	expert-systems aided copying
"	"	telecomm link	"	LOW	VERY LOW	"
+ forms & graphics	"	mail media	"	MED-HIGH	VERY LOW	"
"	"	telecomm link	"	HIGH	VERY LOW	"
+ photos	"	mail media	"	HIGH	VERY LOW	enhanced image processing
"	"	telecomm link	"	VERY HIGH	VERY LOW	"

(continued on next page)

digitally enhanced images when coupled with a computer. Computer technology may also be used to enhance audio or moving images, though today this is found mostly in professional editing equipment. Eventually, digital enhancement may be common in consumer equipment, so that copies are indistinguishable from originals [16].

PUBLISHER'S NOTE:

The following pages are unavailable for filming:

12

PUBLISHER'S NOTE:

The following pages are unavailable for filming:

13

II Digital technology.

> "...we must ask for what we really want and not for what we think we want.... If we ask for victory and do not know what we mean by it, we shall find the ghost knocking at our door." (Norbert Wiener, Cybernetics. [17])

This is a cursory introduction to how information is digitized and how digital information is transmitted and handled in a computer. The technology has many subtleties ignored here, hence this description is simplistic, but suggestive of what actually happens.

Fundamental to all digitization is that the information is encoded by a series of binary numbers (0s and 1s); this permits the computer to manipulate the data. The mathematical theory of information implies that anything seen, heard (or smelled or felt) can be encoded so that it can be faithfully replicated. (It is not simple to do this. Putting the theory into practice has required some forty years of difficult work and many hundreds of billions of dollars. And lot more work needs to be done in some areas.)

II.A Digital Transmission.

The imminent implementation of high-speed digital systems as part of the public telephone networks, will have significant implications for intellectual property rights in the very near future. Furthermore, the movement towards Integrated Services Digital Networks [ISDN], though fraught with political and economic controversy, may make it even easier to access digital integrated nature of the voice, data, and perhaps video on the digital datastream likely may make it virtually impossible to monitor information on the network level.

Noise is inherent in any telecommunications system, degrading the signal at the ultimate receiver. With analog signals, very complex and expensive processing is required to restore the information; and even after this processing, the result is not always as good as the original.

Why digital?

It is easier to regenerate digital signals without any loss of information than it is to amplify analog signals. What this means for replication is that there is no inherent physical limit to the number of perfect copies that digital systems can make.

Digitization offers a non-intuitive method of signal restoration which follows these approximate stages:

1) If not already in digital form, analog information (and the human world appears, in general, to be totally analog) is sampled, according to information theory, at discrete intervals;

2) The digital signal is sent as a series of pulses (binary 0s or 1s). These pulses may be transmitted as discrete voltage changes on wire; an undulating or pulsating radio wave usually modulating another "carrier" wave, through the ether or guided by a coaxial cable or waveguide; or laser light flashes on a fiber optic link. The pulses will degrade, as any signal will, but since the signal detector is only looking for an on/off signal, it is possible to reconstruct a perfect copy of the original set of digital pulses for retransmission.

3) Re-transmission takes place in a computer-like digital device which may also be switching, massaging, or duplicating the signal. Copying is trivial in this environment. Unlike analog amplifier/repeaters which have finite limits to the number of times a signal can be retransmitted before total degradation, digital retransmission can be virtually infinite without any loss of signal quality. Each generation will look, or sound, like

signal quality. Each generation will look, or sound, like the original!

Though digital transmission networks use more bandwidth than comparative analog networks, the cost of bandwidth is dropping sufficiently fast so that telecommunications carriers have planned for an eventual shift to totally digital systems. With the advent of solid-state microelectronics, a totally digital telecommunications system tends to cost less than an analog system, though hybrid networks exhibit many inefficiencies.

In the nearterm, such proposed systems as AT&T's Circuit-Switched Digital Capability (CSDC), which permits sending data at 56 kilobits per second (kbps) over the intercity dial telephone network, and Bell Labs' Local-Area Data Transmission (LADT), converting existing local exchanges into packet data networks, should encourage the proliferation of computer-based information systems. (56 kbps is equal to about 100 text pages per minute. That is also approximately the speed of the Xerox 9600 laser computer printer). [19]

II.A.1 Text.

Textual material can be divided into three basic domains -- alphanumeric characters, mathematical formulae, and graphics.

Alphanumerics is already "digitized", as we noted. Characters are readily encoded into binary numbers which represent most of the world's alphabets [20]. For most information transfer today this is the stopping point, but a powerful level at which to stop. Format, typeface, graphics have been generally ignored in information retrieval systems, because the essence of most written material has been simply text.

being re-keying of the characters. Optical scanners have become quite advanced, but still require expensive manual operation, and have difficulty scanning complex page layouts. The most efficient method for text storage would be directly from word processors, and as WP becomes dominant, direct communication is what is expected to happen. Also, as computer work stations make graphics easier to create and disseminate, the dominance of text in written material may be reduced.

The major technical problem with textual material comes with formulae, graphs, and page layout. With standardization these are not impossible to encode and transmit so that the pages reproduce coherently, but, so far, international acceptance of standards has been difficult to achieve. Without standardization, the progress of computerized information transfer and retrieval will be retarded, since word processors often use incompatible formats.

Eventually it should be possible to program AI "expert systems" machines to treat all forms of textual material as a human would, and properly interpret the page pattern for storage and perfect replication [21]. An interim solution is to treat graphs and formula as "pictures" to be scanned. Data can be stored on the location of lines, dots, gray scales, position, etc. Since white space comprises the bulk of any page, that information can be compressed so that every point of a page need not be stored. Highspeed digital facsimile machines today use standardized algorithms for transmission of compressed data [22], and often the reproduction looks better than the original; cost is not much more than a local photocopy, plus transmission. More sophisticated fax machines store and transmit text as alphanumeric code, inserting the graphics from digitized facsimiles, or regenerating graphics from raw data.

We have reached an era when textual information may have no original; instead all "copies" are originals generated from a computer store. And every "copy" may be unique, prepared on-demand to specific requirements!

II.A.2 Audio.

The sampling algorithm for sound stores a binary number indicating the amplitude of the sound (called "Pulse Code Modulation -- PCM"); this makes the digital signal compatible with computer storage, facilitating such things as processing for noise filtration, and ultimately searching for word meanings [23].

Compression algorithms may be applied, eliminating redundant code and dead space in speech. With digitization, copper-pair telephone lines today carry multiple conversations, or a combination of highspeed data and voice simultaneously. This has permitted doubling capacity, or more, on local telephone loops without stringing new wires; a number of systems are being proposed to take advantage of this phenomena [24].

II.A.3 Video.

Video digitization follows much the same pattern as audio and graphics, but is far too complex to treat in this paper. With compression, full-motion color video is being sent over groups of digitally multiplexed telephone circuits [25]; further compression may make it likely that video conferences can use ordinary 56 kbps digital telephone loops. Compression with full-motion video is particularly intriguing, for some of the proposed algorithms make use of human visual phenomena which could also prevent simple digital interfaces from being built that permit copying what we see; that is, only a human could be the receiver via a proprietary machine designed not to readily permit recording on a permanent media [26].

II.B Digital Computation Devices.

The computer is a funny tool. It does not work in a straight-forward, intuitive fashion, like a press, or a typewriter, or even a teletypewriter. True, in interacting with humans computers resemble these modes -- with an impression on paper, or the depression of typewriter-like keys, perhaps with "input" and "output" separated by vast distances. But here the resemblance ends.

The digital computer is not simply a more efficient extension of older means of communication, nor just a better way to manage information. The stored-program, electronic digital computer is a unique device in the history of technology. It is a machine which may change its own instructions. And any computer -- micro-, mini-, or mainframe -- is a "universal machine," capable of imitating any other computer *without knowing how that computer works*! A digital computer can be programmed to emulate or simulate (and control) any other machine or process knowing only its input and output, and not necessarily its internal organization. (Conversely, an effective emulation barrier can lie in the ability to keep input/output protocols confidential.)

By using clever tricks of arithmetic, the stored-program machine can handle any mathematical and logical function. Though all that the digital computer does is add, compare and shift binary digits ("bits") under program control, using a set of registers or buffer memories for temporary storage, these arithmetic/logical processes give the machine immense power. This power comes from its architecture: its relatively large memory space, rapid mechanisms for input and output, the critical ability to skip to selected instructions according to the result of a previous instruction (the "conditional jump"), and the use of extremely rapid and tiny solid-state logic circuitry. The ability to access other machines, and data held remotely, multiplies the power of the machine by several additional orders of magnitude.

While the earliest designs for such a machine date back to Charles Babbage's 1837 Analytical Engine, the underlying theory behind the computer's power did not appear until Alan Turing's seminal work in 1936 [27]. By the end of World War II, John von Neumann synthesized the key ideas for a modern general-purpose machine [28]; in addition, at that time a handful of perceptive workers saw the potential, and warned of the dangers, of this totally novel device. It was clear to these few that the world would change if the ideal of building self-replicating automata could be achieved. But the electronic technology then was still too primitive to do much more than simple automatic data processing [29]. All machines in use today derive from von Neumann's synthesis, and all digital computers work, more-or-less, in the same fashion, based on the principles first elicited by Babbage, Turing, and von Neumann [30].

The modern computer is sometimes call a "von Neumann" machine; the term "Turing Machine" is used to identify a digital device which is the "universal machine": the machine which can imitate any other, and the fundamental building block from which all more complex machines are constructed. The "Turing Machine" building block may be embodied in hardware or software, or be a hybrid. Programs or novel machine designs can be considered as being made up of numerous Turing machines combined, a notion which is in conflict with much of the concept of proprietary software rights [31]. Some firms embed program instructions in hard-wired devices (actually specially designed microchips with fixed circuitry) which are difficult to disassemble, but can be readily patented, in order to protect their rights to the program design. This eliminates flexibility, but overcomes the problem of defending ideas which are simply an assembly of other ideas [32].

Turing postulated a machine with an infinite or extremely large memory, and never expected to actually build such a device. However, the rapid decrease in cost of temporary and permanent memory over the past three decades has given us machines which approximate a Turing Machine, and has permitted theories of the self-replicating automata to be applied on such computers. This, in turn has encouraged programs which simulate human thinking under the rubric of "artificial intelligence." One area of AI research involves "expert systems" programming which imitate the function of skilled practitioners in a field. (An example is a program that guides Diesel engine mechanics through the steps of repair and maintenance [33].)

Enormous funds have been allocated in Japan, the U.S., and the European Community to produce a "Fifth Generation" of extremely highspeed computers optimized for AI tasks, including the understanding and translation of human language [34]. Though sometimes termed "non-von-Neumann" machines, virtually all of the proposed designs follow orthodox theory by being built up of multitudes of Turing machines or von-Neumann-like processors manipulating digital bits in a relatively conventional manner. These multiple processors would work simultaneously, in parallel, on a common algorithm, with variations of the concept having shared or distributed memory space, program control, registers, etc. The programming task of such machines is enormously complicated [35].

But even the concepts of parallel processing, proposed on a grand scale for the Fifth Generation, were anticipated by the first prototype electronic machines during the War, and by Babbage as well [36]. The problems of protecting intellectual property, engendered by the fundamental concepts of programmable machines, are not likely to vanish in the near future if the Fifth Generation machines are successful; in fact, the issues will most likely become exacerbated due to the machines' speed, power, and networking capabilities. We discuss the problems of AI programming in more detail below.

III. Control of Information Flows.

> "To read a copyrighted text is no violation, only to copy it.... this distinction is reversed with a computer text. To read a text stored in electronic memory, one displays it on the screen; one writes it to read it. To transmit it to others, however, one does not write it; one only gives a password to one's own computer memory. One must write to read, but not to write." (Ithiel de Sola Pool in Technologies of Freedom [37])

III.A Print, and print-like technologies.

We earlier indicated how it was relatively easy to control the flow of printed materials when the process was highly centralized. The economics of the supply dictated the nature of the early copyright laws, whether to protect the investment of the author, the publisher, or the power of the Crown to control information dissemination. Fifty years ago, Professor Arnold Plant, a British copyright expert, began to recognize that the

> "new commerce in ideas and intellectual property .... have become so greatly transformed by ... technological advances as to call urgently for a reconsideration of many of the assumptions underlying copyright legislation" [38]

Plant first cited the change in demand over the past 400 years, including such obvious factors as the:

> "vast population increase;" "the spread of education;" and the "improvements of artificial lighting and the heating of buildings" which effected the "size of the potential market for a performance, or for a single edition of copies, and on the period over which an edition must be held in stock ... to recoup the investment...." [39]

Then Plant noted that "new inventions ... since the first introduction of movable type have greatly reduced unit costs of production," giving as examples:

> mechanical type-setting,
>
> "the making of stereotype copies ... so that gangs of printing machines can produce identical copies in parallel,"
>
> "remote type-setting by one central compositor, so that

> simultaneous editions of identical copies can be produced on printing presses each located in a convenient regional centre of population;" and,

> "the elimination of the cost of keeping type standing [for reprints] by use of photographic methods of [reproduction]...."

Plant foresaw the impact of microphotography, television broadcasting, and sound recording noting "the business of communication have been disturbed and re-cast. Copyright privileges now have a changed significance and effect. Some are obsolete and impede progress, others may need strengthening if desirable developments are to be speeded up." [40]

Though Plant did not anticipate the computer linking these technologies, it was clear that the new technologies had changed the original precepts for copyright because the locus of production and the economics of printing had changed. Unfortunately, neither British nor American law were able to come to grips with these changes [41].

Decentralized Publication

The new digital technologies, and their allied electronic distribution channels are following the same pattern as print technology has over the centuries: decentralization, wider distribution, and lower -- and re-structured -- unit costs. With electronics, a significant portion of the costs of the actual printing and storage of intellectual property will shift to the user's own equipment: the publisher then will keep only the "stereotyped plates" in the form of mass storage; no longer will the warehouse have to keep multiple printed copies (which the new tax code discourages anyway). The reader soon will be able to make his own copies locally. Perhaps the pulp novel and beautiful color "coffee table" book will remain for sale in bookstores and airport newstands, but for the bulk of printed material, electronic distribution and remote presentation is expected to be far more efficient for information presentation and distribution than the existing publishing infrastructure. (Figures 2-4 illustrate several of the technological factors underlying this change.)

Arguments will arise that the technology cannot provide print remotely the same as items from a printshop, and this is but a science fiction dream repeated many times over the decades [42]. This is irrelevant: Sixteen-color, calendared stock may not yet be possible with laser printers, but there is nothing inherent to prevent such processes from evolving when the market is ready. True, such fantasies are not new; we heard variations two decades ago for the electronic college library. Instead of laser printers for remote distribution, we were going to use microfilm [43]. The electronic library never got much further than abstracts on teletypes. Technology is market-driven, and publishers simply were not terribly interested in cutting down on the number of editions sold so that students could make copies of articles and books on demand, without paying royalties. With the lack of demand, the appropriate technology has never developed.

This scenario may repeat itself, but today the demand for quality electronic printing devices, and the information retrieval networks to feed them, is coming from the office automation sector; in fact, the technology is already here for the most part, and is becoming cost-effective. This time the publishing industry may be over-whelmed by new economic and technological forces. The concept of copyright will be forced to change. To expect the economics and rights of publishing to remain the same as when Philip and Mary could monitor virtually all printed materials is not realistic [44].

III.B Digitized Information.

All technology has complex connections to its surrounding infrastructure. When a radical change in one sector takes place, it is foolish to expect everything else to remain the same. The automobile did not simply substitute for the railroad, it decentralized land use, living patterns, and radically changed society. Yet all that initially changed, technologically, was that the engine was placed on the vehicle instead of pulling a train of cars; and the vehicle no longer had to follow a track (owned by a common carrier) but could utilize the public system of roads. Little details are important. Recursion appears: Even the road carrying the vehicle completely changed!

So it will be with digitized information. Once text, for example, is encoded so that a computer can store and retrieve it, radical forms of retrieval become possible. We can use Boolean search schemes to find and match information; text can be compared among multiple sources to find selected facts, errors, or omissions; a user can be alerted when certain information enters the system [45].

One of the more radical changes will be text treated as a "logical" process trigger, not just a static source of information. The store-and-forward computer can be programmed to act on information; an automatic stock trading program may be activated when the computer reads certain types of news, perhaps comparing the news to an historical trendline from diverse retrieval systems, or to an algorithm of its own design. Elementary forms of such programs have been around for several years; they do not even qualify as AI or expert systems. We are not far from the time when advanced versions will begin to have important impacts.

Another example can be found in the proposed protocols for international electronic mail, and for videotex and teletext systems [46]. Message headers can contain not only the usual alphanumeric fields for addressing, but logic fields which could activate processes during transmission and reception. Though intended for automatic ordering systems, acknowledgements, etc., the logic fields are sufficiently open to permit unique and innovative uses. The mails will never be the same when the envelope itself can trigger action!

It is easy to see that when control of information gets so de-centralized that remote machines will be making automatic decisions on the information -- decisions which may not be foreseen or anticipated by the designers of those machine much less the current user -- the ability to protect intellectual property will have passed beyond our ken. For the law, this will be the point of absurdity.

III.C The stored-program machine.

What happens in a digital computer that makes the protection of intellectual property difficult if not impossible? Let us take a cursory and over-simplified look at the passage of some data through the machine:

All data -- to make things clearer, let's say the data is alphanumeric text, binary encoded -- which enters the machine must be temporarily stored in a "register" or some kind of a buffer. All processing, manipulation, transmission and retransmission of digitized information, instructions, and results of machine decisions *must* be delayed for at least a fraction of a second for a digital computer to perform its binary arithmetic and logic processes; store-and-delay is the essence of its central processing unit.

What makes concepts of copyright protection archaic is the way digital processors move encoded text-data between locations. Data is *copied* from one buffer-register to another, *copied* from the buffers to the processing units, *copied* from input buffers to output buffers, *copied* from registers to central memory, and *copied* from temporary memory to permanent storage (which may be far distant).

In copying, text in the register or memory may or may not be destroyed or altered, depending on register architecture and how the instructions are written. So in telecommunicating text on computer networks, the switching store-and forward machines cannot be considered as mere neutral transmitter-repeaters (as on telegraph lines) but as duplicators *extraordinaire*, all linked together in a gigantic system of distributed intelligence.

You can imagine all this copying of bits as a tiny bucket brigade, emptying some holes and filling others until some result is achieved. The result may be a display of letters on a screen, or on paper, or perhaps not displayed at all, but stored on some physical medium. Or the bits in the buckets may enter an intermediate state, waiting for something else to happen. Billions of bits may pass through the buckets in a register-buffer until a certain pattern tips one special bucket which rings a bell. This pattern might fit the message "war declared," or some such. Or instead of ringing a bell, it might tip a bucket which means "sell stock." Or more usefully, it might fill a distant bucket in some other machine which says, "the stock is sold," and simultaneously fill a set of buckets elsewhere enriching your bank account and debiting another.

This only a rough scenario, of course, but the point is that "reading" of electronic, computer text does not infer that a human is involved; however, any reading using digital computers does imply copying, and copying many times over. There is simply no parallel to the kind of text reading with which we are normally acquainted. Further, there is no way for an originator of electronic information on an open network to have control over what mode of "reading" or copying may take place somewhere down the line. Ever. (Related to this is a fundamental concept behind the digital computer: that it is impossible to know in advance all of the potential results of a program.) [47]

The nature of computer processing is such that at any one time there may be multiple copies of a text residing in various parts of the machine, or spread all over a multi-machine network. Some of these copies may be intended to be transitory, and some copies may stay around for a long time until some other program or text needs its memory space and overwrites it. But there is no guarantee of its erasure.

The entire process so far described may seem trivial, for moving just one bit at a time, or even thousands at a time, is not terribly earthshaking. But with modern solid-state electronics photoengraved on tiny pieces of silicon, the digital computer has entered a different age: a typical business personal computer moves these bits some six million times per second. A PC's temporary memory today can be configured to hold bits equal to more than a million characters, or 300 pages of text. And it can transfer these million characters to a hard disk for permanent storage in about a minute. (Using a system like CSDC on the dial-up telephone network, this one-minute transfer could be to or from the other side of the Continent.)

III.D Programs.

The computer does not contain just data or text, of course, but also programs which are lists of instructions telling the machine what to do with the data. A fundamental concept behind the invention of the stored-program machine is that there is no difference between the binary numbers which represent the data and the binary numbers which represent the instructions!

Only the context in which the machine finds the numbers tells it how to interpret them, and what to do next. A line in memory (usually called a "word") which is data at one time may become an instruction another time; this permits a program to jump around upon certain conditions, to modify itself, to run itself as a subroutine (Ada Lovelace, Charles Babbage's co-worker, termed recursive property "a program eating its own tail" [48]), and to do other useful tricks. From the point of an outsider, making sense of the numbers stored in the core at any point in time (or being shuffled between co-ordinated systems via telecommunications) requires a detailed knowledge of the program and the data; and even then, it may be humanly impossible to determine what is happening.

The problems of protecting rights to program code of the type with which we are familiar today pales by comparison to that of AI programs. Since the trend appears to be toward self-learning systems, in the next section, we emphasize the novel over the more mundane:

III.E Artificial Intelligence.

The process of recursion is basic to the machine's ability to be self-learning, a principal feature of AI programming. Learning systems can be inductive, producing new rules (stated in the form of computer algorithms), or analogic, in which causal structures or patterns are inferred based on previous cases and producing new data structures under program control [49].

Both types of AI programs are built up from multifarious, previously encoded structures to the point where tracing the inputs may be impossible, particularly without the cooperation of the programmer. The programmer (or the computer, or both) makes an observation which is encoded into an algorithmic rule for the machine: What if another machine, or programmer, makes the same observation, and comes up with the same rule? What if, due to the program structure, computer architecture, or other variables, the machine code for the rule appears different (assuming it can so delineated within millions of lines of code) but has precisely the same effect as some other programmer's rule? What if the machine, itself, produced the rule? What rights does a programmer -- or the owner of a machine -- hold in these rules?

Should the machine's vendor hold rights to whatever the machine does in the future (forever?) even if the machine is sold outright? Suppose the owner modifies the machine, or uses a program from another set of vendors? (We are no longer dealing with questions which emanate from the information contained within printed books!)

Expert Systems.

Expert systems basically study and attempt to replicate a domain of human learning or expertise. Are these natural processes, simply observed by human or machine? If the domain is a structure, does a human or machine have rights to this structure? An example: it has been proven that it is possible for a machine to analogically learn the rules of parsing -- "the process by which the phrases in a string of characters in a language [human or machine language] are associated with the component names of the grammar that generated the string." [50] (We parsed English in high school when we diagrammed sentences to show what were the nouns, verbs, objects, and how they related to each other.)

Again the question of property rights looms: If a machine learns the parsing rules (that is the machine, not a human programmer, is the center of causality due to its own action), who owns the parsing program which the machine generated? What if software written by owner A develops a parser on a machine architecture owned by B which parses text (owned by C) and turns the text into a novel way of encoding natural language (a new semantic network)?

Another further example: what if the new semantic network (owner not yet determined) is used to reason and develops a novel international relations theory which can summarize and synthesize cases (retrieved online from owners D, E and F) and makes new inferences for a balance of power concept? Who owns the rights to the use of this expert systems tool in dealing with a foreign state?

These examples go far beyond the legal interpretation of a translation, though the machine is doing language translation of a sort [51]. Furthermore, this has not been a random choice, but it is currently a real research endeavor. The point is that all machine knowledge is linked, but with the advent of AI and automata applications, two basic issues will have to be faced for intellectual property rights:

1) if restrictions are placed in the use and re-use of information, particularly information readily accessible via telecommunications, further progress in the art may be stymied, to echo Plant's worry of a half-century ago; and,

2) since computer code is effectively encrypted, with the key held by the programmers (and even they may not be able to delineate any particular element of code in a large program); and since growing data structures will represent many different sources of information, not all of the same weight, and not possible to determine their origins, arguments about intellectual property rights in programming may equal medieval arguments on how many angels can sit on the head of a pin.

It may be best to resolve these questions now, before the art gets bogged down in useless legal proceedings.

III.F Networks.

Electronic mail is a form of publishing. And it can be so simple: after typing your message, all you do is type a name or number, and instantaneously the message is sent to your correspondent. Now suppose that message is a copy of some article you just read sent from your electronic publisher's computer. To display the article (which you, of course, paid for when you requested it), it must be stored in some kind of a memory-buffer. There is no difference between this memory and the rest of memory storing the computer program which accessed this article. Most microcomputer access or terminal programs have a "switch" which permits retaining a copy of the display in memory and writing it to disk, or printing it. (And even if the access program does not permit retention, there are other ways to accomplish this with a microcomputer [52].) Inserting a copy of the article in your message is equally trivial. In fact, a logic field may have been set to do this automatically without prior questioning [53].

So you may have violated the copyright laws by sending the article to a friend, or maybe it falls under "fair use." The problem an electronic publisher must worry about is that you send the article not to one, but to two friends, or ten, or a whole list stored in your machine and accessed with just one keystroke. And then they send this article to two friends, and then ....

If each recipient re-transmits the article to just two others, and it is re-transmitted once every 15 minutes, how long before the whole world sees it? (2 raised to the 32nd power is 4.29 billion.) [54] What has changed from the problems of the ordinary office photocopier is the scale of network connection, the speed of transmittal, and the almost complete lack of labor input in making copies.

§ § §

No one had ever objected to the sharing of printed text, or even to the re-sale of a printed book after one had read it. Such objections would have been rediculous and impossible to enforce though some economic harm to the originator may have been done. With copying, the sharing is extended in power; when copying became trivial, of course, publishers became worried and have lost credibility in the eyes of the public (though not in the law) by attempting to control the use of copying machines.

With computer-based information retrieval, human reading, and sharing of information, requires display -- that is the only way, unless one wants to read machine code in the form of magnetic blips under a microscope. To share some information, one may have a colleague come over to one's terminal. But it is just as easy -- maybe easier -- to press a button and send that information to an electronic mailbox, or to an electronic copier. Any attempt to control that is futile.

IV. Critical Problems and Some Solutions in the Protection and Dissemination of Intellectual Property.

"In my end is my beginning." (Mary Queen of Scots)

Publishing, as we know it, is undergoing a radical change with the impetus coming from a radically different technology. The characteristics of this new technology indicate that:

1) The definition of "copying" is too vague, for all digital machines copy in order to communicate. Digital logic devices are essentially repeaters re-generating 100% perfect copies, and this is done many times within a computerized system. The issue was manageable when data processing was centralized, but with networks of ten of millions of interconnected machines, replication of intellectual property, especially textual materials, has become easy;

2) Foolproof protection of machine code, data, text, and other machine-readable, digitized materials is impossible with open computer systems. Exacerbated by telecommunications links, the machines' copy-and-repeat characteristics make this obvious. If a "lock" can be overcome without detection, legal prohibitions become unenforceable.

3) Legal protection of programming code will require much more complex evidentiary processes. This follows from the inherent capability of a machine which can emulate any other machine without copying its instruction set. Furthermore, since, by definition, computer programs are made up of multitudes of other programs, arguments separating novel work from that in the public domain, or "natural" processes, brings a new interpretation to the Constitutional clause encouraging "the progress of the Arts and Sciences" [56]. Strict enforcement of intellectual property laws in this case would, no doubt, cast a pall on future research in Artificial Intelligence.

4) The locus of creation has become fuzzy in the machine age. Works may be created virtually anywhere, by machines or people; synthesized in other locations; created in multiple locations simultaneously; presented, "read," or utilized similarly in multiple locations; and other complex and variable permutations presented by intelligent, distributed networks of computers. (Obviously, industrial and labor protection schemes dependent on location of production become moot in the computer age too.) But, underlying all of this is the novel concept that control of intellectual property has passed from the originator or owner to the user or destination machine.

Solutions will not come easily.

There are no quick technological fixes, but there may be some partial solutions. Still, any legal solution will most likely be extremely complex, as befitting the extreme complexity of the technologies. Non-legal solutions may be better in terms of the over-all public good; these would be mostly economic and social.

IV.A Evidence in the electronic age.

The first protection for intellectual rights is to have some simple and verifiable proof that you created something worth protecting. (This is doubly important if a machine may be able to create something just as good as your idea.) Existing copyright procedures are cumbersome, and for machine-generated material pretty silly, since machines can be cleverly programmed to fake most anything.

A basic problem for copyright verification may be that it will be too hard to prove priority for complex creations, such as involved computer programs or databases. In fact, priority itself may have to be redefined as we have noted for Artificial Intelligence and other programs.

One suggestion would be to embed in any program -- or text -- a unique, verifiable time-date identifier generated by a truly random process. The ID algorithm might be encrypted using a public-key system, so that only the holder of the ID can create it, but anyone can read it [57]. The ID could be received online from a central telecommunications link, maintained by some international authority, so that "registration" would be easy, trivial, cheap, and universally accepted. One might "register" a "copyright" frequently, or continually, during the course of creating a text or a program, so that the act of creation would have a readily auditable trail. The maintenance of the neutral authority would be important for verification in case of dispute.

Much needs to be done to make this a viable idea: there are questions about how and where the unique ID would appear in text or a program. Perhaps it would be linked to an algorithm which works like a cyclical redundancy code (CRC) [58] for error-checking of blocks of the text, or for the entire text. Perhaps for pictorial material, the ID could be part of the raster, such as timecode in the video vertical blanking interval [59]. This could be useful to trace piracy in future all-digital television systems. Pattern recognition to determine uniqueness may also be applicable [60].

If electronic mail networks include some way of reading a meter which can decode the unique ID, and if the online metering system is sufficiently complicated (and sufficiently inexpensive), the computer paradox may work for the publisher in that it would not be worthwhile to defeat the meter. Even today, where it is possible to copy most anything that is machine-readable, it is not practical [61] in terms of the cost of one's time, or a user's ability.

Even the honor system can be made to work, if the economic pressure is not excessive, for example, the scientific and engineering community may be willing to pay a small fee each time an item is read as a contribution to the maintenance of the system of distribution, and if the overhead is not burdensome. With computers the overhead can become automatic. However, if a publisher becomes greedy, rebellion could also become automatically programmed.

But no such system can totally foolproof. Some novel software or hardware simply may not recognize the ID code. Some agencies or governments may feel that no charge is proper, and administratively work to defeat such a system. And for some intellectual works, an quasi-honor system will make no sense to the users.

IV.B Closed vs. open systems.

There are ways for computers to distribute electronic text without concern for unauthorized copying at a mass scale. Totally closed systems, such as airline reservations networks, require an expert for unauthorized access. But people with such skills usually have better things to do with their time rather than fooling around with penny ante publishing rip-offs.

The trend seems to be to open systems where the sender has little control over ultimate use. While complete control over terminals, or the distribution process, could solve the copyright problem, it might also limit the market [62]. Lexis, for example, which once could only be accessed via special equipment on a special network (actually the "network" was composed of automatically dialling sealed modems in most cases, but the user was generally unaware of this) is now available to anyone with a microcomputer. Once a non-proprietary piece of equipment enters a network, particularly equipment which has many other functions besides accessing a certain database, control is eliminated, as we have discussed in previous sections [63].

A similar possibility to maintain control is with semi-closed infrastructure, such as software which only permits viewing but not printing or saving to disk. Again, such software is probably much too straightjacketed to attract significant market penetration, especially if it does not print. Proprietary hardware for printing is possible, making it difficult to manipulate so that multiple copies can be made, or data stored without permission of the publisher, but the same basic objections arise:

1) if it is worth copying, finding some mechanism to defeat the protection scheme is highly likely, especially over the long-term;

2) the utility of the information is greatly reduced if confined to unique devices which lack hard copy, storage, etc.;

3) the future of information retrieval lies in making great use of the interactive, logical, and intelligent mechanisms inherent in the computer, such as comparison, automatic search, automatic alerting and flagging, interpretation, synthesis, messaging, and other symbiotic powers likely not yet discovered;

The same objections can be made as to isolation of intellectual property in the form of moving images and sound. Audio is already on the open network, and is becoming easier to manipulate and copy. Video and motion pictures will go through somewhat different scenarios, due to their complexity, but the principles remain. Indeed, with interactive video, the constraints may be more harmful than for other forms of intellectual property, because of the ~~power~~ utility of the video medium.

IV.C Only evolving information may be protectable.

The vast power of the digital computer lies in its architecture permitting self-modifiable instruction sets (the stored program) to manipulate information in digitized form. However, our laws and social structures never before have had to take into account the influence of a machine which can perfectly emulate other machines, and can even modify itself!

This is the computer as a robot, an automaton. Admittedly, the implications of automatons are quite puzzling and disturbing to many people. Yet, in the long run, with the development of artificial intelligence and "expert systems" programs, the computer's logical mechanisms may become part of an electronically published work, not just its means of delivery.

Compensation.

How then to compensate authors, editors, compilers, programmers, artists, and even publishers (assuming they remain viable elements of the distribution system)?

There is a probable solution, one spurred by the computer-publishing revolution itself: It may be that collecting residuals from intellectual work will only be economically viable and legally practical if works are continually revised [64]. Copyright for the data itself may be irrelevant in this context, though protection of the program which generates the information may be more important than ever.

For works that never change, the electronic publisher may be forced to finds ways to collect the bulk of its income up front. If an electronic work has any permanent value, it may *de facto*

-- if not legally -- enter the public domain. This is both due to the nature of networks, as we have explained, and to the nature of intellectual work. What we have struggled with under the term "fair use" is simply that the need to use creative works by other creative people is in conflict with the idea of property rights. So we have invented all sorts of rigamarole to justify some use but not other uses, without ever being able to write precise guidelines [65]. Just as we think we have the genie penned in his bottle, another invention for replication comes along and lets the genie out again. The digital computer, as Norbert Wiener pointed out soon after its invention [66], is the ultimate genie.

IV-D Unanswered questions.

We need to watch the system of evolving computer software carefully. Market surveys are important in order to understand just what is happening in the real world of mass distribution of programs and machine-readable text. While legal answers to the problem of protecting property rights may not be forthcoming and, perhaps, letting the market solve these issues may be the only practical way, there are still many puzzles. For example:

1) Collecting revenue up front instead of over the long term through residuals or re-issue, is precisely what appears to be happening today with microcomputer software. Yet this is not really in line with the theory expressed above, since such materials are most likely to change. Perhaps the market has not matured sufficiently for software publishers to dig in for the longer term with software updates, continual support, etc. We do not yet understand the mass market -- as opposed to the original specialized market -- for computer software. Centralized mainframe data processing treated the economics of software in ways not applicable to the future.

2) What about work-in-progress? When an author, or programmer for that matter, worked in a garret, new work could be protected, even if shown to others. Giving a new work a copy-

right at birth does not have much meaning when automated message networks yield geometric replications.

3) What about protection for an author's or publisher's reputation against libel, defamation, and distortion? Re-calls do not work with computer mail/publishing. Programs can be written to change the meaning of text, re-distributed as if it were authentic. Will a unique ID be sufficient for authentication [68], or is a total system required?

4) How do we continue to encourage creativity in the arts and sciences in the computer age if laws restrict the use of prior art and science, or if authors and artists are not compensated for their work? Must we establish compulsory licensing for all intellectual property? How can we establish a workable system to collect these fees, and at what level will such fees strike correct balances among benefits to society, gain to the originator of the work and the publishing entity, and be feasible to enforce?

5) How does one identify a copyright work when the work is in complex machine code? By its output? Suppose the output is variable depending on use, user, time, inputs, relation to other machine code and machines? Suppose a variable output is so variable that the variations fit no discernable pattern? How does one cite such a work? Indeed, what conventions are we to use to cite anything that comes over a network, including messages, fragments of information, and work in progress?

6) What does the location of creation or storage mean on a network, especially if the network itself adds or modifies the information content? What does this mean for labor and manufacturing protection and barriers?

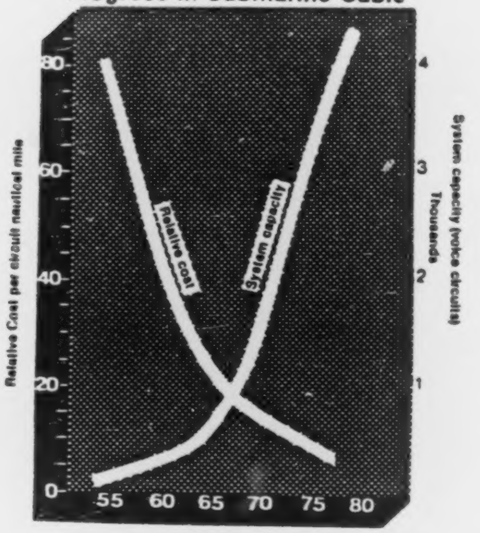
IV.E Conclusion.

It may be that it is simply too early to do anything but observe the free growth of the new technologies. Constraint before a system matures may be the worst thing that could happen; worse, since digital networks know no boundaries: If we, in the United States, hamstring our growth with rigid laws, some other political entity may use their relative freedom to maneuver to our disadvantage [69]. We have seen this happen with anti-trust, and it would be unfortunate if we spread these concepts to intellectual creativity.

APPENDIX

Figures illustrating Technological Changes Related to Information Transfer

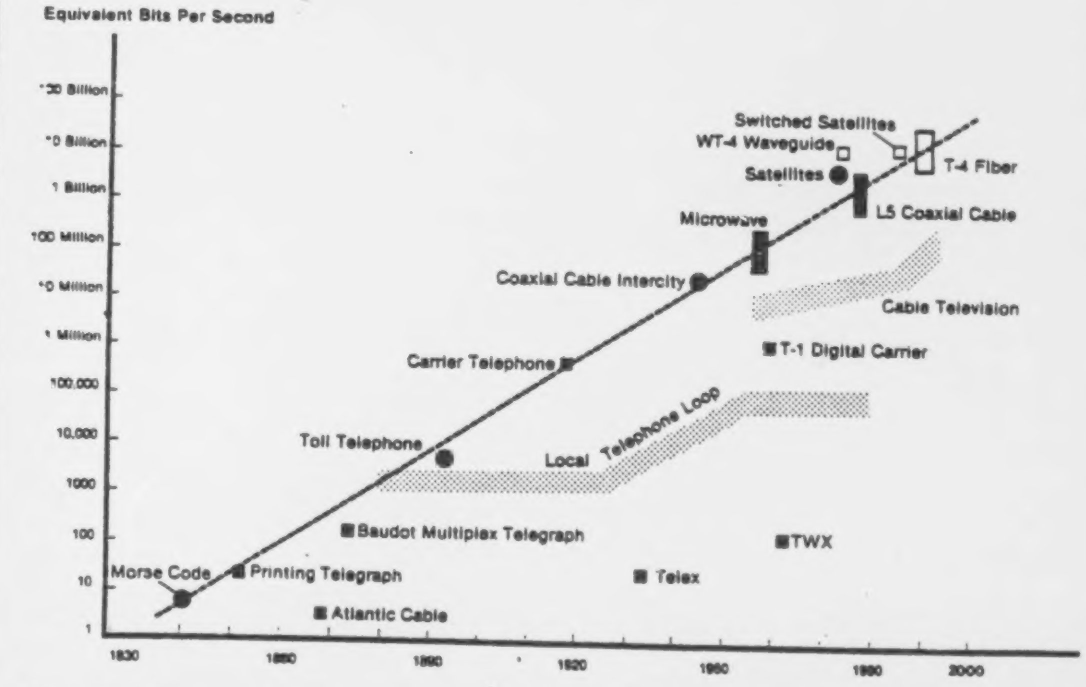
Progress in Submarine Cable



Source: B.M. Dawidziuk, Standard Telephones and Cables, Ltd. in *Telephony*, Sept. 24, 1979

> "Man is a tool-making animal."
> — Benjamin Franklin

The Sequence of Inventions in Telecommunications, 1840-2000



Source: Richard J. Solomon and John Ward, M.I.T. Adapted from James Martin, *Future Developments in Telecommunications*, 1976.

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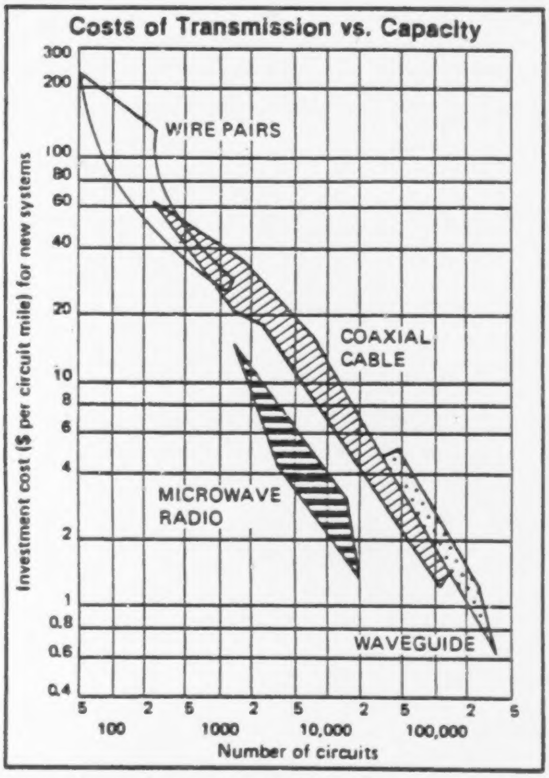
Used with permission.

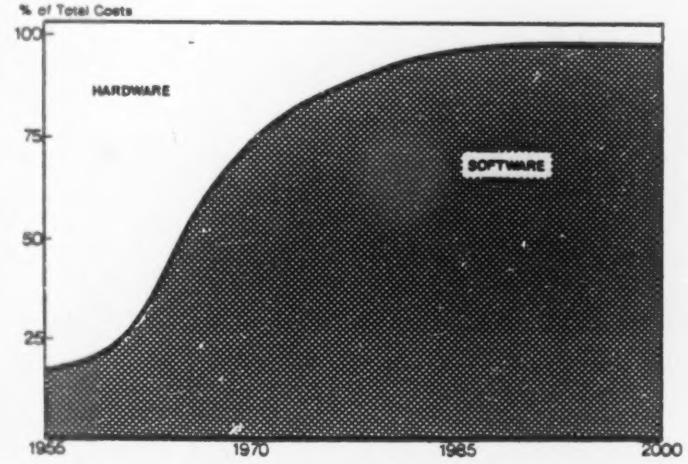
6. *Barriers and Opportunities: Technological Gateways*

"Invention breeds invention."
— Ralph Waldo Emerson


Costs of Transmission vs. Capacity

Source: Harvard University Program on Information Resources Policy. Adapted from O'Neill, Eugene F., "Radio and Long Haul Transmission." *Bell Laboratories Record*. Jan., 1975.

Computer User's Development Costs



Source: *Worldwide Semiconductor Industry*, 1977.

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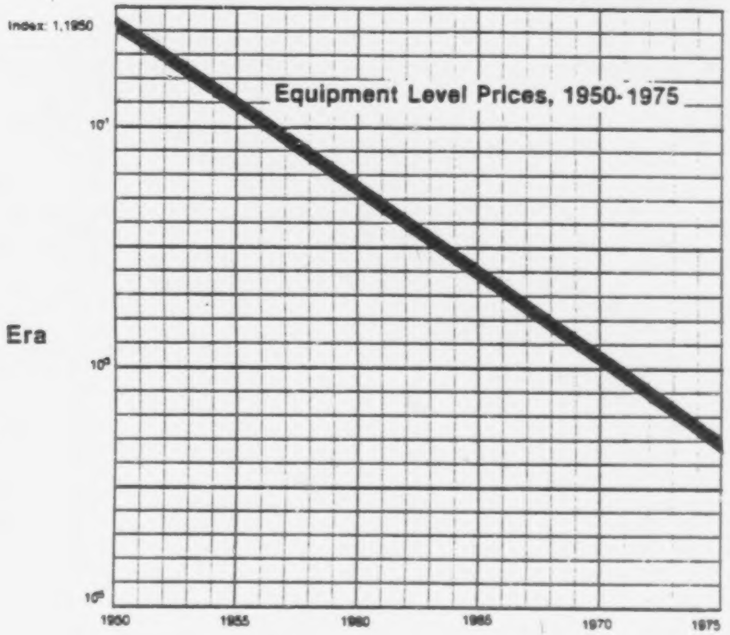
Used with permission.

Relative Cost Trend Per Electronic Logic Function



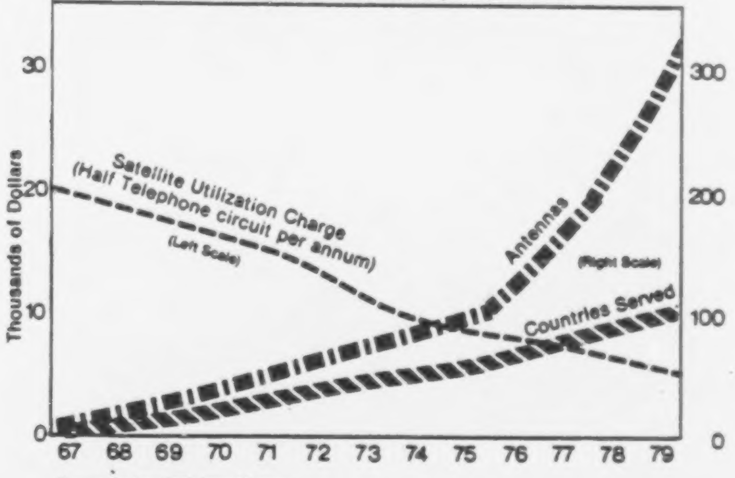
Source: *Datamation*, June 1979, p. 111

Product Lifecycles in the Microchip Era

Mainframe computers: 4 years
Telephone private exchanges: 5 years
Communications satellites: 5 generations in 20 years
Teleprinters: 1½ years
Video displays: 4 generations in 5 years
Semiconductor memories: 4 generations in 5 years
Microprocessors: 3 generations in 5 years
Packet switching: 3 generations in 8 years
Integrated circuit test equipment: one year

Source: Manley R. Irwin, *U.S. Telecommunications Policy Beyond Regulation*, Max-Planck-Institut Fur Auslandisches und Internationales Privatrecht, Bonn paper presented February 11, 1980.

Intelsat Satellite Utilization Charge vs. Earth Station Antennas, 1967-1979



Source: *Intelsat, 1979 Annual Report.*

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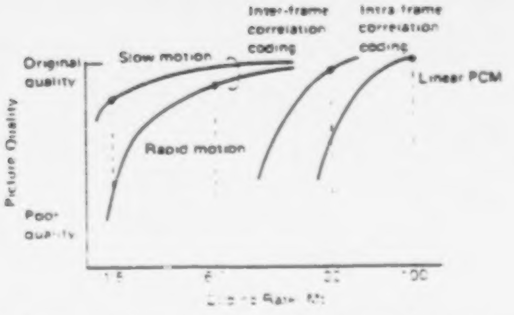


Fig. -Relation between coding rate and picture quality

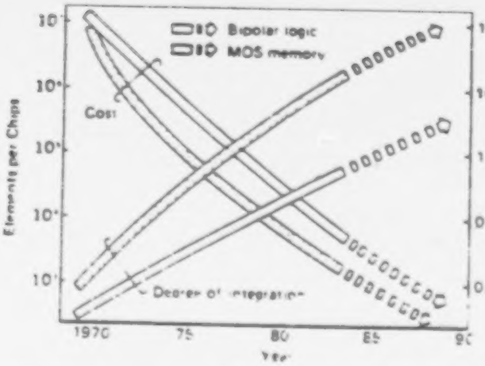


Fig. —Trends for LSI cost reduction and degree of integration.

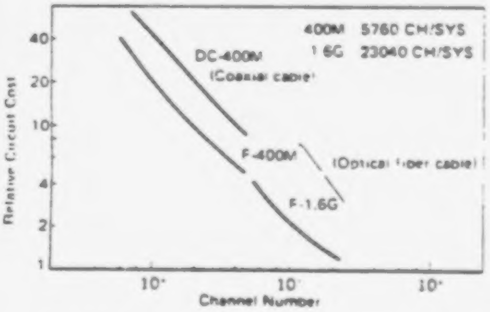
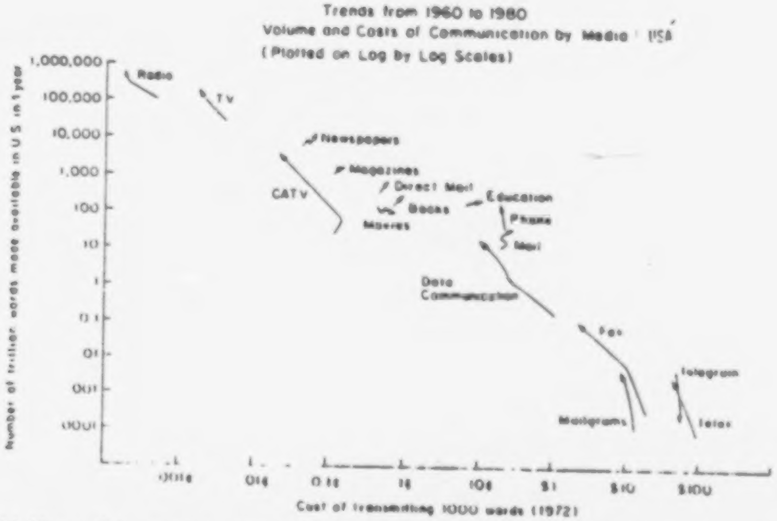


Fig. —Tra

Above and left, F. Fukutomi, in Review of the Electrical Communications Laboratories (NTT Japan), No. 2, 1984.



While the cost trends for print media remain steady, electronic media costs have dropped dramatically in the past two decades. (**Chart from Communications Flows, by Ithiel de Sola Pool, Hiroshi Inose, Nozomu Takasaki and Roger Hurwitz,** University of Tokyo Press or Elsevier, New York. 1984. Reprinted with permission.)

Footnotes

1. Part I, Book 3, Chapter 3.

2. Many of the ideas developed in this paper came from discussions with my colleagues at the MIT Research Program on Communications policy: Loretta Anania, Roger Hurwitz, John C. Mallery, Gavan Duffy, and, in particular, the late Professor Ithiel de Sola Pool.

   With Prof. Pool these concepts were explored in embryonic form for the Organization for Economic Cooperation and Development (OECD), and presented at a conference in Paris during 1979. See Pool & Solomon, "Transborder Data Flows: Requirements for International Cooperation," in Policy Implications of Data Network Developments in the OECD Area, OECD, 1980, p. 79-139 and Pool & Solomon, "Intellectual Property and Transborder Data Flows," Stanford Journal of International Law, Vol 16, Summer 1980, pp. 113-139. See also, International Networks newsletter, "Computers & Highspeed Telecommunications: The Old Copyright Rules May No Longer Apply to Intellectual Property," February, 1984.

   Prof. Pool developed these thoughts further in his book, Technologies of Freedom, The Belknap Press of Harvard University Press, Cambridge, 1983, esp. chapter 8, "Electronic Publishing," and in a paper, "Whither Software Copyright," posthumously delivered by this writer at The Annenberg Schools of Communications' Washington Program conference, "Electronic Publishing Plus," May 10-11, 1984, (scheduled to be published in a book by that name, edited by Martin Greenberger, in Fall 1984).

3. After years of frustration trying to bring language translation machines to the market, the advent of the micro- and minicomputer has made it economically feasible for human translators to have the bulk of their dogwork done by machines on their desk. Now there are several products on the market that promise to do even better than that if rough translation is all that the user requires. The Japanese Fifth Generation computer project, endeavors to contain language understanding and translation as part of its basic operating system.

   See "Automated Translation Is Now Some Sense Making," The New York Times, July 29, 1984, Section 4; Waldrop, M., "Natural Language Understanding," Science, vol. 224, 27 April 1984, pp 372-41. A minicomputer translating 3,000 words an hour, from Japanese to English, costs $85,000 and works with 90 percent accuracy. Fujitsu, Hitachi and NEC Corp. are expected to offer mainframe system in the next few months; "Translation

Systems on the Horizon," Japan High Tech Review newsletter, vol. I, No. 6, June, 1984, p. 6.

4. Hendrickson, J. B., "Synthesizing Chemicals by Computer," Technology Review, April, 1984, pp. 24-29; Lindsay, R. K. et al, Applications of Artificial Intelligence for Organic Chemistry: The DENDRAL Project, McGraw-Hill, 1980. On AI, see note 34 below.

5. "The right only began to assume importance when the invention of printing made the multiplication of 'copies' of a work infinitely quicker and cheaper than the painstaking products of monkish scribes, as well as appreciably more accurate than the compositions of most professional scriveners." I. Parsons, "Copyright and Society," in Essays in the History of Publishing, p. 31, A. Briggs, ed, 1974; also see Kaplan, Benjamin, An Unhurried View of Copyright, Columbia University Press, 1967, chapter I, "The First 350 Years".

6. Grossman, Bernard A, "Cycles in Copyright," in The New York Law School Law Review, Vol. 22, Nos. 2 & 3, (1977); C. Blagden, The Stationers' Company, 1960.

7. Grossman, op. cit., p. 363.

8. Plant, Sir Arnold, "The Commerce in Ideas and Intellectual Property," The Stamp Memorial Lecture, University of London, 1953; Plant, "The Economic Aspects of Copyright Protection in Books," Economica, 1934; Hattery, L. H., and G. Bush, eds., Reprography and Copyright Law, Baltimore: Port City Press, 1964.

9. Type and typefaces should not be confused; each has its own information content (and both forms of information can be stored by a digital machine). Text is stored by a machine encoded in a binary representation of the alphabet; the typeface regenerated -- and the page format -- may not represent what the original looked like, if there was an "original." But with modern word processors, the presented copy could be regenerated exactly as the author intended -- as on Apple's Lisa and Macintosh machines (Byte, Feb. 1983). This may offer a new complication in copyright, since the variations and permutations of copying will be vastly multiplied by machine manipulation.

See "Languages and Codes," in Chapter 2 of Colin Cherry's On Human Communication, (2d Ed., Cambridge: MIT Press, 1966), -- an excellent introduction to the technologies and application of printed language as communication systems; also "Alphabet." Encyclopedia Britannica, 1911 and 1969 editions: Shannon, C. E., "Communication Theory of Secrecy Systems," Bell System Technical Journal, Vol. 28, pp. 656-715, October, 1949.

10. Cherry, op. cit., "The Mathematical Theory of Communication,"

pp. 41-52, and passim; Shannon, op. cit..; Aaron, M. R., "PCM Transmission in the Exchange Plant," Bell System Tech. J., vol 41, no. 1, pp. 99-141, January, 1962; Engineering and Operations in the Bell System, Bell Telephone Laboratories, 1977, section 10.2.4 "Short-Haul Digital Carrier," and 9.5.5, "No. 4 ESS."

IEEE Transactions on Communications, and Trans. on Information Theory, publish current papers in the field of digitization. For background on applications see Aaron, M.R., "Through the digital processor," Trans. on Comm., vol. COM-26, May 1978, pp. 489-492; Ahamed, S. et al, "A Tutorial on Two-Wire Digital Transmission in the Loop Plant," Trans. on Comm., vol. COM-29, Nov. 1981, pp. 1554-1564.

For a significant application of digital voice, see Nussbaum, et al, "Voice Storage in the Network," (special issue on the 1A Voice Storage System) Bell System Tech. J., vol. 61, no. 5, May/June 1982, pp. 811ff.

Digital graphics: Rosenfeld, A. and A. C. Kak, Digital Picture Processing, Academic Press, 1982; Casey, R. G. and G. Nagy, "Advances in Pattern Recognition," Scientific American, -----, pp.56-71; Brown, C. M., "Computer Vision and Natural Constraints," Science, vol. 224, pp. 1299-1305, 22 June 1984; Kolata, G., "Esoteric Math Has Practical Results," Science, vol. 225, pp 494-5, 3 Aug. 1984.

Graphics Standards: the Association for Computing Machinery (ACM) Special Interest Group on Graphics (SIGGRAPH) monitors the field. See ACM Computing Surveys, December 1978, special issue on graphics standards, for a general backgrounder; also Meads, J., "The Graphics Standards Battle," Datamation, May 1984, pp. 76-84; NAPLPS (North American Presentation Level Protocol videotex graphics), 3 part series in Byte, Feb.-March, 1983.

11. Ohmori, T, et al, "Facsimile Intelligent Communication Systems, Present and Future," (special issue on fax) Review of the Electrical Communication Laboratories, (NTT, Japan) vol. 31, no. 4, 1983, pp. 463-507.

Federal Express is now offering a hybrid fax/delivery service, New York Times, July 30, 1984.

12. Interview with Dieter Pohl, head of R&D for Bosch Fernseh AG, West Germany, Videography, September, 1983; "High Definition TV Comes at High Cost," High Technology, July 1983, pp 45-48; "Digital TV: makers bet on VLSI," IEEE Spectrum, February 1983, pp 39-43.

The Bell Labs Picturephone II project in the early 1970's outlined the basics of digital video (Bell System Tech. J., special issue on Picturephone, March 1971.)

Some of the potentials of digital video are outlined in Staelin, D. H. and B. I. Szabo, "Protocol Definition for Flexible Image-Coding Algorithms," unpublished paper (1982), Dept. of Electrical Engineering and Computer Science, MIT (this paper represents current work in progress).

The field is very fluid, and is followed in the *Journal of the SMPTE* (Society of Motion Picture and Television Engineers), *IEEE Transactions on Consumer Electronics*, and *Journal of the Institute of Television Engineers of Japan (Terebijon Gakkaishi)*. See note 15 below.

13. These arguments can also be made for the information in core memory, of course, or any volatile memory. There are two subtle differences: 1) core memory is an essential element of data processing (it could not exist without it), and some form of input-output system is implied by core which does store tangible information long enough to be examined if required; 2) there is great likelihood of non-volatile core memory components (not losing their memory if the power is turned off) being used in future machines. These could be bubble memories which retain data without power, or CMOS devices which require a low power drain to hold its last binary state. The differences between transmission systems, then, and memory is that there is no way for transmission to retain their momentary information state (which may last less than a billionth of a second) *without* a terminal device, which could recirculate the information, while computer memory may *be* that terminal device which recirculates and interprets the information on transmission lines. *Or, in other words, you cannot take a core dump of a link, only a node!*

If this appears as quibbling, then consider that the problems of control for intangible media meeting the three tests in the text are the *same* as that for core memory treated as separate from the rest of the digital processor; the problem of control does not go away!

Also see "CMOS Future for Microelectronic Circuits," *Science*, vol. 244, 18 May 1984, pp. 705-707.

14. Hawken, *op. cit.*; Overhage, C. and R. Harmon, *Project Intrex*, MIT Press, 1965.

One of the earliest electronic digital computer projects made great use of microfilm technology for mass storage. The "Memex" machine, designed by Vannevar Bush of MIT in 1937 found its way into World War II cryptographic work and apparently was never completed. (Work-in-progress by this writer; also see V. Bush, *Pieces of the Action*, Morrow, 1970; Randell, B., *Annals of the History of Computing*, vol 4, no. 4, Oct. 1982, pp. 337-341). Eastman Kodak later built a more modern version of this machine, marketed under the name Memorex. Kodak has recently announced more advanced hybrid products which merge computer-output microfilm and electronic digital imaging (Wall Street Journal, June 20, 1984, p. 18).

The technology and law of copyright related to information retrieval may have taken a different course had Bush's special-purpose hybrid digital device entered production before general-purpose machines, instead of a decade afterwards.

15. See note 12 above. On videodisks' current status: "The Videodisc Revolution," Broadcast Engineering, April 1984, p. 282; "Erasable optical disks could be here in 1985," Electronics, July 14, 1983, p. 54.

Switched video: Schenkel, K. D., "BIGFON -- An All-service Subscriber Communication System Goes Into Operation," in 4th World Telecommunications Forum, sect. 3.11.7, part II, vol. III, ITU, Geneva, 29 Oct.-1 Nov., 1983.

16. Scientific American, -----.

17. MIT Press, 1948, p. 177.

18. For an introduction to ISDN technology, see Electrical Communications, ITT, vol. 56, No. 1, 1981, special issue. Also "Design Approaches and Performance Criteria for Integrated Voice/Data Switching," Proc. IEEE, vol. 65, no. 9, September 1977, pp. 1283-1295; Electronic Switching, (CNET, French PTT research labs), chap. VI-2, "The Future," Elsevier, 1983. Also see 4th World Telecomm. Forum, op. cit., session 2.8, and passim. See also note 10 above.

For a background on digital switching in telephone networks: Joel, A.E. Jr., "Digital Switching -- How it has developed," IEEE Trans. on Comm. vol. COM-27, July 1979, pp. 948-959.

19. "Local Area Data Transport," AT&T Bell Laboratories Tech. J., vol. 63, no. 6, part 2, July-August 1984, pp. 1113-1190; also on local area networks (LANs), Flint, David C., The Data Ring Main, Wiley, 1983; Estrin, Deborah, "Data Communications via Cable Television Networks: Technical and Policy Considerations," MIT Laboratory for Computer Science report MIT/LCS/TR-273, May 1982.

CDSC: Data Communications, Nov. 1983, p. 53, and March 1984, pp. 45-46; also Ahamed, op. cit., and note 10 above.

"Xerox 8700 Electronic Printing System, Reference Manual," Xerox Corp., July 1982, No. 930002.

20. Articles by I. Flores on "ASCII,", "Codes," and "EBCDIC" in Ralston, A., Encyclopedia of Computer Science, Van Nostrand, 1976; Becker, J. D., "Multilingual Word Processing," Scientific American, July 1984, pp. 96-107.

21. See note 34 below.

22. See note 10.

23. Cherry, *op. cit.*, note 10 above; Waldrop, *op cit.*, note 3; Aaron, *op. cit.*, note 10.

24. See note 10.

25. Bodson, D. and R. Cotton, "The government's first step towards standardizing TV-motion gear," *Data Communications*, May 1984, pp. 143-148; "Versatile codec gives overseas TV parleys," *Electronics*, June 30, 1983, p. 96. See also note 12 above.

26. Staelin, *op. cit.*, and conversations with Prof. Staelin at MIT.

27. Hyman, A., *Charles Babbage* Princeton, 1982; Hodges, A., *Alan Turing*, Simon and Shuster, 1983; Hopcroft, J. E., "Turing Machines," *Scientific American*, May 1984, pp. 86-98; Weizenbaum, J., *Computer Power and Human Reason*, Freeman, 1976, p. 58; Turing, A. M., "On Computable Numbers, with an application to the Entscheidungsproblem," *Proceedings of the London Mathematical Society*, 2d series, vol. 42, part 3, pp. 230-265, Nov. 12, 1936.

28. *id.*, and Goldstine, H. H., *The Computer from Pascal to von Neumann*, Princeton, 1973; von Neumann, J., "First Draft of a Report on the EDVAC," reprinted in Randell, B., *The Origins of Digital Computers: selected papers*, Springer-Verlag, 1982; Metropolis, N., et al, editors, *A History of Computing in the 20th Century*, *passim.*

29. Wiener, N. *The Human Use of Human Beings*, Houghton Mifflin, 1950, and *Cybernetics*, *op. cit.*

30. Hopcroft, *op. cit.*; and Hyman, *op. cit.*

31. Hopcroft, *op. cit.*; and Weizenbaum, *op. cit.*, chap. 3-4.

32. Though code in a "Read-Only Memory" (ROM) is just as unreadable as any compiled or object binary code without the correct machine and documented dis-assembly program to aid in deciphering the code, courts have recently ruled that programmed ROMs can be copyrighted. It is not clear how one would certify that the code in contention is the same as the code in the ROM, however. See "Computer Copying Stirs Legal Snarl," *N. Y. Times*, July 5, 1983; *Atari, Inc., v. JS&A Group, Inc.*, No. 83 C 8333 (N.D. Ill. Dec. 1983), *Computer Law and Tax Report*, vol. 10, no. 7, Feb. 1984, pp. 1-3 and no. 9, April, 1984, pp. 3, 8.

Another version of the embbeded code which may be eligible for patect protection is microprogrammed control in a computer's central processing unit (CPU). See Pattern, D.A., "Microprogramming," *Scientific American*, March 1983, pp.50-57;

Davidson, S. and B. Shriver, "An overview of firmware engineering," *Computer*, vol 11, no. 5, May, 1978, pp. 21-33.

33. *Modern Railroads*, ---, 1984.

34. An enormous amount of literature has recently appeared on AI, Fifth Generation computers, and expert systems research. A useful summary is in a recent 5-part series in *Science* by M. Waldrop: 24 Feb., p. 802; 23 March, p. 1279; 27 April, p. 372; 15 June, p. 1225; and 10 Aug., p. 608 (1984). Duda, R. O. and E. H. Shortliffe, "Expert Systems Research," *Science*, vol. 220, pp. 261-268, 15 April 1983, has a thorough bibliography; also Waltz, D. L., "Artificial Intelligence," *Scientific American*, October 1982, pp. 118-133; Winston, P. H., *Artificial Intelligence*, Addison-Wesley, 1977.

35. Waldrop, *op. cit.*, pp. 609-10.

36. Waldrop, *id.*; and Hyman, *op. cit.*; comments of John Mauchly in Greenberger, M., *Computers and the World of the Future*, MIT Press, 1962, pp. 236-7.

37. *op. cit*, p. 214.

38. Plant, (1953 lecture) *op. cit.*, p. 6.

39. *id.*

40. *id.* p. 9.

41. *National Commission of New Technological Uses of Copyrighted Works, Final Report*, 1979, p. .

42. *Printing Impressions*, April 1984, pp. .

43. Overhage, *op. cit.*, pp. .

Watkins, H. S., "A survery of color graphics printing," *IEEE Spectrum*, July 1984, pp. 26-37; See also current issues of *The Journal of the Society of Information Display*, and *The Journal of Imaging Technology*.

44. Kaplan, *op. cit.*; Hattery, *op. cit.*, *passim*.

45. Wessel, Andrew E., *Computer/Aided Information Retrieval*, Wiley, 1975. Also Licklider, J. C. R., *Libraries of the Future*, MIT Press, 1965, esp. chap. 3; Bush, V., "As We May Think," *Atlantic Monthly*, vol. 176, pp. 101-108, July 1945 (the Memex project cited in note 14 above); Pool, *op. cit.*, pp. 214-217.

46. Cunningham, I., "Electronic Mail standards to get rubber-stamped and go worldwide," *Data Communications*, May 1984, p. 159; "Teletex Terminal Specification," Deutsche Bundespost (West Germany), 2.Draft 1982; special session on Teletex,

Conference Record, IEEE International Conference on Communications, June 19-22, 1983, Boston, pp. 781-896.

47. Hopcroft, *op. cit.*; Turing, *op. cit*; Hoare, C., and D. Allison, "Incomputability," *Computing Surveys*, vo. 4, No. 3, September 1972, pp. 169-178.

48. Hyman, *op. cit.*, pp. .

49. See note 34 for general references on AI.

50. Ralston, *op. cit*. pp. 1044.

51. *id*., p. 1045. 17 U.S. Code ---.

52. A useful introduction to how a *real* microcomputer *really* works may be found in the non-mainstream manuals on operating systems, such as: Norton, P., *Inside the IBM PC: Access to Advanced Features and Programming*, Bowie Md.: Robert J. Brady Co., 1983; and, Worth, D., and P. Lechner, *Beneath Apple DOS*, and *Bag o' Tricks*, Reseda, Ca.: Quality Software. These books typically are associated with software utilities, available on a disk, to help in reading all disk sectors (including the hidden ones) and examining core memory.

    Similar programs have always been necessary for de-bugging mainframes, one of the earliest is IBM's "Disk ZAP". There are literally hundreds of such programs, few copyrighted, and many downloaded from computer bulletin boards and other systems. There are no conventions established for citing such intellectual property, particularly in light of their transitory nature.

    Also see Osborne, A. *An Introduction to Microcomputers*, Vols. 0 and 1, McGraw-Hill 1980.

53. See note 46 above.

54. 8 hours.

55. Pool, *op. cit.*, chapter on "Electronic Publishing."

56. *Constitution*, Art. I, Sect. 8.

57. Diffie, W. and M. Hellman, "New Directions in Cryptography," *IEEE Transactions on Information Theory*, IT-22, pp 644-654, November, 1976; Rivest, R., A. Shamir, and L. Adleman, "A Method for Obtaining Digital Signatures and Public-Key Cryptosystems," *Communications of the ACM*, vol. 2, No. 21, pp. 120-126, Feb. 1978; and Meyer, C. H., and S. Matyas, *Cryptography*, Wiley, 1982, Chapter 9, "Digital Signatures."

58. Sobolewski, J. "Cyclic Redundancy Check," in Ralston, *op. cit.*, pp. 382-385.

59. Schubin, M., "More Than You Will Ever Want to Know About Time Code," Videography, Nov. 1983, p. 26; American National Standards Institute (ANSI) standard no. V98.12M-1981 and proposed Society of Motion Picture and Television Engineers (SMPTE) recommended practice RP 108.

60. Kolata, op. cit. (3 Aug. 1984); Casey, op. cit.

61. Seymour, J., "The Software Outlaws," Today's Office, August 1984, pp. 20ff; "Downloading and Piracy," Download newsletter, May 1984, pp. 13-14.

62. Information providers are making a concerted effort to encourage microcomputer users to connect to their systems, for example, where Prestel, the British Videotext system, used to require the purchase of special TV sets for access, now the marketing push will be to have PC users connect by using terminal-emulator software (talk by Richard Hooper, British Telecom, at a conference held by The Annenberg Schools of Communications Washington Program, May 10, 1984); also, "Mead Stresses Data Growth," N. Y. Times, April 23, 1984, p. D1.

63. See note 52.

64. See paper in preparation by Stanley Besen for this project.

65. For example, the results of Sony vs. Universal Studios (78 L. Ed. 2d) offered no useful new guidelines on fair use, and despite years of litigation, one suspects the plaintiffs are not being hurt economically: "Hollywood Thriving on Video-Cassette Boom," N. Y. Times, May 7, 1984, pp. 1, C17; "Movie Studies Put More Emphasis on Home Video, Pay-TV Markets," Wall Street Journal, May 1, 1984, pp. 38, 42.

66. Cybernetics, op. cit, an analogy to Goethe's "Sorcerer's Apprentice," pp. 176-178.

67. The mass software market is followed by a large (but diminishing) number of publications. Some useful ones are Software News (monthly), Infoworld (weekly), Softalk (monthly), and PC Week. Download newsletter is a new monthly covering the innnovative concept of sending software via telecommunications directly to stores and users' microcomputers.

68. See note 57.

69. As may be the case with the recent proposal of the Japanese Ministry of International Trade and Industry (MITI) to shorten the copyright term for computer programs protected in Japan to 15 years and mandate compulsory licensing. Opposed by the U.S. and the Japanese Education Ministry, the underlying concept by MITI was that good ideas should not be held back by extremely long copyright lives. The MITI proposal called for "special legal protection of computer programs on grounds [that] software is industrial property different from litera-

ry work protected by the existing copyright law." ("Software Bill May be Partially Rewritten"; also, "MITI Sticks to Software Rights Bill," and "MITI Drops Controversial Software Bill," Kyodo News Service, online from Dow-Jones News Service, Mar. 12, Mar. 16, and April 20, 1984).

Also "Protecting Intellectual Property," Speaking of Japan, May 1984, pp. 15-23 (pub. by the American Chamber of Commerce in Japan, Tokyo); and ACCJ Trade/Investment Barrier Survey Follow-up, 1983.

Similarly, Brazil appears to be permitting the copying of microcomputer software that is "overpriced" -- at least, by Brazilian standards. In essence, many individuals may feel that they have the same privileges, even if not encouraged to do so by their government; we may expect many more sovereign countries, especially the LDCs, to simply look the other way when it comes to protecting copyrights of the industrialized states if they feel they are being overcharged (there is some evidence that this has been happening with textbooks). On international networks, all control will be lost if this becomes accepted practice. (Foreign Broadcast Information Service, JPRS-TTP-84-).

A Conceptual Framework for Organizing Observations About Parties Interested in Property

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A CONCEPTUAL FRAMEWORK FOR ORGANIZING OBSERVATIONS ON INTELLECTUAL PROPERTY STAKEHOLDERS

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A. Purpose

The purpose of this paper is to develop a conceptual framework that the Office of Technology Assessment can use to organize its information about the views and interests of the various parties (stakeholders) concerned with intellectual property. The interest group information will come from interviews, workshops, etc. A conceptual framework is needed to categorize types of stakeholders in a functional way rather that just lists of groups or media.

A conceptual framework is needed to categorize types of interdependencies among the stakeholders so that the instrumentalities (law, policies, custom) which affect performance (who gets what) can be identified. The purpose is to permit the grouping of items from lists of technologies and media which create the same kind of interdependence (conflict or opportunities for cooperation) so that policy makers can better identify how alternative legal structures affect the direction of performance. This should have some relevance to the question of whether Congress can develop laws which can produce the same general performance as selected previously even in the face of technological change; or whether the law will always be lagging technological change. The framework should also suggest the relative ability of different parties to affect decisions.

B.Methodology and Sources

The ideas for development of this conceptual framework come from theories of public choice, welfare economics, public finance, institutional economics, law and economics (see Schmid, 1978). The basic framework has the following components: situation, structure, performance (SSP). Situation describes the character of the goods or services and the people involved which creates interdependence, i.e. affects how one party's acts affect another. Structure refers to formal and informal laws and rules (rights) which define which parties can take which action, i.e. define relative opportunities. It is rights which turn person A's interests into costs for person B. Situation and structure interact to produce a set of consequences or performance which can be variously described such as income distribution, technological change, or the ability to affect political change or self-help.

C.Interdependence of Stakeholders

How do the actions of one type of interest group affect another? Where will the contests, opportunities and issues arise? Is a particular sort of interdependence controlled by a particular sort of institutional structure? Each kind of information and technology has a set of characteristics which shape human interdependence with respect to its use. Survey data and observations may be organized to illustrate how a given type of rule affects performance when controlling a particular case of interdependence (category of good, technology, or service). This analysis then can be used to predict how the same kind of rule would affect performance when newly applied to another example in the same category. Or, it can suggest how the same rule produces different results when applied to different categories of goods. Some of the same categories help to understand the resources that different groups have to affect decisions. The use of these resources such as political contributions and persuasive information is also institutionally controlled.

1. Incompatible Users or Uses

Incompatible use creates interdependence between individuals. When one person's use of a good means it is unavailable for use by another, individuals contending for the good conflict in the face of scarcity. For example, if one person uses a certain frequency in the radio-magnetic spectrum, this use is incompatible with other would be users. This interdependence is controlled by the structure of factor ownership--someone is given ownership (or its equivalent) to control use of a good. This may be a use right only or a tradeable right. To own is to make others come to you if they want to make a use of the good or service in question. A license to use a TV channel is a type of exchangeable factor ownership.

Conceptualizing information and ideas as incompatible use commodities can be tricky. It is useful to distinguish between a medium (technology or mode of distribution) and content of information. The radio-magnetic spectrum and video cameras are a technological medium while the information content of a TV signal is conceptually different and raises different conflicts among stakeholders. In one sense, the use of information content by one person does not physically use up the product and prevent use by another, as will be discussed further below. Such use may, however, be incompatible with realization of market revenues. The incompatibility arises in that the closeness of substitutes affects returns to investments in creativity. Copyright is a type of factor ownership controlling the incompatibility and conflict of interests.

The scope of activity that one has exclusive rights to must be specified in order to determine what substitutes are allowed. This will be referred to here as product space. Rights define the range of activities which are exclusive. There is always a continuum of product and activity features necessitating a designation of the threshold between mine and thine. The issue can be captured in the question, "how different is different?" Society may in principle wish to give ownership of the content of a novel or musical composition to its author. The definition of what product space means is discovered when there is an accusation of infringement and the defense says that the alleged copy is significantly different and outside of the protected product space. Several examples of conflict over the definition of product space are noted below:

(a). Transformations. The protected work may be transformed by someone other than the author is some manner, such as a foreign translation of a book, an abstract, expression in a different medium such as conversion of printed material to electronic signals, or transmission of local broadcast TV to distant points via micro-wave and cable. These kinds of conversions will be discussed further below in section five on marginal cost equal zero. If a transformed work has to pay something to the owner of a protected work, the transformation is regarded as derivative. But, this is largely a name applied to a policy choice rather than a guide to it.

(b). Changes with intent to copy. Some competitors will make cosmetic changes which do not change the function of the information with the intent to avoid the property right. The problem here is what one person regards as cosmetic may be regarded by another as a fundamental improvement. For example, what proportion of a copyrighted computer applications program must be different before it is not regarded as a copy? Baumgarten (1984) notes that "The cases to date have involved the defendants' reproduction of from 80% to 100% of the plaintiff's program: we have yet to see where the courts will draw the line between the protected expression or literary aspects of a program and the unprotected methodology or processes of a programmer, particularly in cases of less substantial appropriation."

(c). Inventing Around. This category differs from the previous one in degree and intent. Some competitors do not intend to copy or simply make cosmetic changes. They want to create a substitute for the protected good. In patent circles this is referred to as inventing around the patent. The public may wish to reward the creator of information, but it may not wish to prevent all conceivable substitutes. At some point, a new idea is enough different to be regarded as non-infringing and itself eligible for rights. For example, many firms have tried to develop IBM-compatible computers without infringing on IBM's copyrighted chips (Rubin and Strehlo, 1984). The policy issue again is how different is different enough to be regarded as a legitimate substitute for a protected work.

(d). Independently created, but similar. When people are working on the same problem, they may come up with similar solutions. There may be no intent to copy, but the results may be similar though different. Again, how different is different? The law takes various views on the issue with proof of derivation placed on one or the other party or turning on whether the alleged copier had access to the owner's work (Breyer, 1970, p. 348). If independent creation is allowed in principle, there can be significant transaction costs in proof. If it is disallowed, there is a broad product space allowed free of substitutes and competitors.

The policy issue in all of the above examples is the definition of product space which controls allowable substitutes and directly affects the rate of return to creative efforts. The law usually tries to pick a product space concept and then lets the resulting rate of return implicitly fall where it may. These concepts include definition of what constitutes a performance, who is a viewer, what content is decipherable by a person, what is a machine, and what constitutes a duplicate. But, in the absence of explicit rate of return objectives, application of a given concept causes the rate to vary greatly among classes of information and over time as new technologies are added. This is not to say that public policy should be the same with respect to all creative efforts. The public attitude toward the rate of return is hard to describe generally. It may be related to the size of the investment, the size of the improvement over previous products, or creativity may be distinguished from mere sweat. But, these are different issues than trying to decide whether the information content of a computer operating system should be treated differently if it is external software or etched on a chip.

Factor ownership is often more nominal than real. By statute, the public owns the radio-magnetic spectrum, but has never realized any return from this nominal ownership. The Federal Communications Commission gives free licenses to eligible applicants. So it is a public right to set conditions for others to use, and not for sale (exchange). Yet, statements of public factor ownership can affect attitudes with respect to related transactions.

For example, when consumers copy music and TV programs, the originators of this information regard it as theft; but, the consumer copier may have regarded the profits resulting from the free license to the channel user as theft, and the copy is just a small payment for rental of the public's air waves which it was never able to collect for monetarily. So from one perspective of factor ownership some act is theft, while from another it is a collected payment long since due. These incompatible use conflicts are hard to settle once and for all and keep coming up as opportunities present themselves.

While incompatibility of use is the source of many conflicts, it is often combined with other features. Thus, as the following situational categories will show, factor ownership and competition do not control all of the interdependence and conflicts among stakeholders.

2. Exclusion Cost

Historically, the physical medium and information content were packaged and sold together. The producer of content got paid because it was relatively easy to collect for the particular medium that embodied it. The author and the printer got paid when a book was sold. It was costly for others to duplicate the content in another physical unit of the medium. But, this has changed and media and content are now more easily split. For example, in the past a consumer got the content of a musical recording when the physical medium (tape or record) was purchased. But, now the content can be lifted out of the medium originally used by its creator.

Factor ownership may give a person the right to exclude others, but if the cost of exclusion is high, it is an empty right. For example, it is costly to detect a person making a tape of music on the radio or a movie on TV. If reproduction were expensive, factor ownership would still be effective in spite of high exclusion cost. But, today reproduction and transmission to other sites has become cheap.

When a computer receives data and stores them for manipulation, it is easy to send on to others in a network. This sharing is private and decentralized (hard to detect). Copies are cheap to make and transmit.

There are alternative strategies which may be used to offset the inability to exclude. The opportunity to use these strategies is controlled by the structure of rights. One strategy is planned obsolescence. The customer comes back to the original seller because the copy is obsolete or incompatible with other components of a changing system. Another strategy is learned ethics which foreclose copying even where possible. Another is to tie (bundle) goods with low exclusion cost to those with high. An example is documentation, user support, and warranties tied to software. People who have not paid for the software can be easily excluded from these related services. This tie-in sales right is a matter of policy. Various court cases are addressed to forcing inter-related products to be sold separately.

The information content of a broadcast TV signal is a high exclusion cost good. It is financed not by direct payment of its users, but by advertisers. Advertisers can be excluded if they don't pay, while viewers can not. In Europe, it is common to finance TV by taxes. This means that people may not pay in proportion to use. The same occurs in the U.S. system since the person who pays more for soap to cover its cost of advertising may not watch TV soap operas. These conflicts are inherent in high exclusion cost situations.

The concepts used to analyze the performance consequences of alternative intellectual property rights can also be used to analyze political action. Exclusion cost is a major factor in the ability of an interest group to affect decisions. These decisions may be the result of lobbying to obtain favorable intellectual property rights or self-help collective action. One of the key facts influencing group success is whether the benefits obtained by group action can be limited to group members. If the product of group action is available to non-contributors because of high exclusion cost, people are tempted to be free riders.

The free rider problem is affected by size of the group. More members may mean more resources to affect decisions, but it also means that the individual can't see the effect of her non-participation. Also, large groups face increased transaction cost (discussed below) in getting agreement, and social pressure to conform is hard to apply. When a group has many members, but individual stakes are small, it will be difficult to act as a group. In a group with few members and high stakes for each, the non-contribution of an individual is clear. Sometimes a large group will overcome the free rider problem because of a sense of community and internalization of habits often related to its history and experience with other kinds of collective action. A sense of moral outrage may also affect group solidarity.

High exclusion cost situations also occur in an international context. Jamaica was taking HBO movie signals from satellite transmissions meant for paying cable subscribers in the U.S. The Jamaican government then distributed the movies over its broadcast station. The U.S. government at the urging of the movie industry put pressure on Jamaica in the form of possible withdrawal of foreign aid and favorable tariffs under the Carribean Basin Initiative. This is a kind of bundling or tie-in sale of a low exclusion cost good (tariff) to get payment for a high exclusion cost good (HBO).

3. Interdependence In Demand

The value of information to an individual may be related to the number of other people who have the information. Demand can be a function of the acale of total use. People are interdependent because one person's welfare may depend on the number of other people who also use the information. Use by person A does not affect the amount of the information available to B, only its value to B. The relationship may be negative or positive.

For example, certain information may be a "snob good" and if others are also using it, it loses its value. In additions, the value of information to a few people may be high if it remains a secret, but of little value if shared. Insider stock market information is worth a lot to a few, but little if widely known. The Securities and Exchange Commission regulates the release of this type of information. Certain business data on prices, costs, and qualities and volumes can constitute a competitive advantage if possessed by one side of the market or a few firms. Laws requiring firms to provide information to Census takers can make formerly secret information widely available. Other rules relating to court procedures (discovery and subpoena) affect information availability. The needs of privacy are mixed with those of competitive advantage.

Care must be taken in relating exclusivity of information to value. Information such as business conditions which would change the value of a firm's stock would command a high value if sold to a few, but is worthless if widely available. But, the competitive advantage thet exclusivity confers may be a zero-sum game. Those that would otherwise lose can benefit from shared information even if it can't be sold. Because of the exclusion cost discussed above, a group that will lose if a few others have information will not be able to make a bid for the information. Government regulation and requirements to divulge certain information protects the interest of those who can't organize a market bid.

The value of information can also be enhanced by wide sharing. This might be termed the "bandwagon effect". When something is fashionable, it becomes more valuable because no one wants to be left out. For example, a TV program may become a topic of conversation and one must watch to be socially acceptable. Some creators of information such as certain computer software may encourage copying in the hopes that it becomes the industry standard. Where communication is involved, people want to buy the popular brand of software that allows them to communicate easily with more people and to get help with problems. This creates more demand and sales even if some are lost to copies.

4. Economies of Scale

The character of the cost function for production creates additional sources of interdependence. Products which require large fixed investments mean that cost per unit falls as more units are made. This raises questions of pricing policy affecting different kinds of buyers. Producers can charge different prices to different buyers to increase sales, raising questions of equity. Competition does not dictate a unique pricing policy and producers have a wide latitude of choice.

For example, the extra cost of an additional subscription to a magazine is low. Publishers often offer first-time subscribers a rate lower than the renewal rate for current subscribers. Current subscribers may regard this as unfair, but current law permits it.

Many issues of standardization of products turn on achieving economies of scale. For example, in discussing the information needs of scholars, the librarian of Columbia University has said, "the nightmare is already upon us in the guise of rapidly proliferating data bases, incompatible hardware and software systems, rapidly evolving technologies, communication systems which provide marvelously efficient but closed loops and links to nowhere..." (Battin, 1984, p. 15). There are two major bibliographic networks called OCLC and RLIN which together contain 24 million records. However, they are not linked and therefore most libraries only have one or the other. The cost per unit of service would fall with linked accessibility. There are problems of remuneration for copyrighted material that often prevent easy to use links between data bases (Ringer, 1972). A closed system on proprietary machines avoids unauthorized use, but it loses the economies of scale in use of linked multi-purpose computers. For example, the data base Lexis could once only be accessed via special equipment, but is now available to anyone with a microcomputer (Solomon, 1984).

There are numerous other examples of failure to achieve standardization and economies of scale. AM radio stereo has been delayed for years because there are five competing systems. The same problem occurs with high definition TV (Geller, 1983, p. 36). The two formats for video cassette recording cause retailers and rental firms to carry duplicative stock. These problems are reminiscent of the "communications" costs when there was not a standard track gauge for railroads.

Economies of scale are particularly important in data protection technologies. For example, firms are offering direct broadcast via satellite. The producer of the programs rents or sells a dish to a customer to receive the program for a subscription fee. But, this is a high exclusion cost good, and consumers can buy their own dish and capture the signal without subscription. In response, the program producers scramble the signal, thus necessitating some type of decoder. These decoders add to the cost of the subscription and thus the producer would like them to be as cheap as possible. If there are economies of scale in the production of scramblers and decoders, it pays to have an industry wide standard technology. In this context, the Bureau of Standards is putting forth data encryption standards. A parallel situation exists in the case of software copy protection devices. This raises a host of policy issues since industry cooperation can also be the framework for anti-competitive collusion. While a standard can lower per unit cost, there is a problem of quality improvement over time and how to move from one standard to another.

5. Marginal Cost Equal Zero

The polar case along a continuum of goods with ever declining cost to scale is the situation where the marginal cost of another use or user approaches or is zero (MC=0). This is the opposite of the incompatible use good where use by one person forecloses use by another. Here, an added user subtracts nothing from a previous user. While marginal cost is zero and a marginal user could be charged zero, the fixed cost must be paid by someone. Since MC=0 is the extreme version of declining cost to scale, the same kind of public policies relative to differential pricing control the interdependency arising from the situational character of the cost function.

If the law allows, producers will charge higher prices to some buyers to cover fixed cost, while others get a lower price only covering variable cost. There is a conflict among consumers and each wants to be included in the group paying only marginal cost. The performance at issue is income distribution since the utility of one's income depends on the prices one faces.

Some computer software developers are willing to price differentiate for multiple users such as business vs. training and education. This is possible because the marginal cost of another copy is very low. Price differentiation can be used simply to maximize profits by getting some net revenue from customers who otherwise would not buy at all. Or, it can be used to accomplish some distributive objective such as serving educational goals by giving educational buyers a price closer to marginal cost. This raises the question of who is designated the intra-marginal vs. marginal user. Maybe small business firms would like to be included in the cut rate group _vis a vis_ large business.

From the users' viewpoint, the group enjoying the low price is delighted, but the high price group may not regard it as fair. If a flat price had been charged to all, it might be lower that what the high price group is currently charged.

The marginal cost of another phonograph record or another diskette copy of a computer program approaches zero. When one set of buyers pays enough to cover the original fixed costs, additional sales constitute "rents" (return above the cost of production). This gives pricing latitude to sellers. Different buyers can be charged different prices to maximize net returns or to achieve specific distributional objectives.

The "fair use doctrine" is a way of mandating that some zero marginal cost users are actually charged zero price. The general principle has been that the doctrine applies where a new zero priced use does not reduce the revenue to the originator that was received before the new marginal use was made. In other words, if the originator was covering fixed costs before and after a new use was made, there was no (or limited) claim to any value created by the new transformation. A key question is whether the new use substitutes directly for the old use, or finds a new market. Implementation of a fair use concept requires public choice of distributive objectives which decides who pays fixed costs and who pays only marginal costs; or, if revenue exceeds total cost, who shares in the rents as among the various input suppliers and between producers and consumers.

The issue has been summarized by the Register of Copyright (reported in Homet, 1984) who "has suggested that present enforcement systems are too much concerned with unauthorized use and not enough about the division of rewards between creators and exploiters. 'Increased attention' he has written, 'must be given to how payments for the use of protected works are distributed as well as how they are collected'".

To better understand how alternative rights structure the conflicts among stakeholders made interdependent by the MC=0 situation, several applications will be considered. Information content is often transformed in some fashion into new media and these transformations do not consume the original or affect its cost of production. New users associated with the new media add nothing to the cost of the content. For example, in the case of printed material, such as a novel, the words can be translated into a foreign language. The translation has a cost, but it doesn't affect the cost of producing the original content, Nevertheless, the principle was long established that the original writer shares with the translator in the revenue from the sale of translations. This is current policy and is contrary to the fair use concept since foreign translation is a new market and does not subtract from sales in the original language.

The same information content can often be expressed in different media and the technological evolution of media has been going on for a long time. For example, when movies were invented, the question arose as to whether a novel or a play could be transformed into film without the copyright holder's permission (MGM v.Bijou Theatre Company, 59 F. 2nd, 1st Cir. 1932).

As reproduction and amplification equipment improved, it raised new questions. In Buck v. Jewel-Lasalle Realty Co. (283 U.S. 191, 1931) the Court held that unauthorized playing of copyrighted musical compositions over the hotel's loud speakers was an infringement. These choices were expressed as interpretations of what constitutes a "performance" since this is the language of the copyright law. But, the functional policy issue is one of whether rights extend beyond the recovery of fixed costs to include more of the total value created by the transformed product. There is a conflict among the creator of the content, the transformer into different media, and the consumer.

Another much discussed instance of MC=0 is that of reprography--machines that can cheaply copy printed material. The copy allows another use to be made which adds little relative to the original cost of writing and publishing. It may, however, be a perfect substitute and reduce demand for the original. This is an empirical question that is often hard to prove. Is the reduction in demand for published novels and scientific journals from fair use single copies greater than the reduction in record sales from prohibited, unauthorized playing of music in hotels?

When player pianos were invented, copyrighted music was transormed into perforated rolls. White-Smith v. Apollo (209 U.S. 1, 1908) ruled that such use was not an infringement. The Court argued that the rolls were not copies since they were not a duplication of the original sheet music, were not decipherable by a person, and that the rolls were part of the machine. But, functionally, the interdependence conflict was arising from MC=0 and the policy issue decided was how to share in new revenues when fixed costs were otherwise covered. If the law could be written in terms of distributive objectives, it would not be continuously made obsolete by technology which changes what is a duplicate, what is a machine, and what is intelligible notation. For example, the performance objective might be stated as follows: after fixed costs are covered, rents are limited to a certain rate of return and anything over that amount would be eliminated by allowing fair use. This could be implemented regardless of the new technology and without reference to interpretations of what is decipherable or what is a machine, etc.

While on the subject of music, it would be useful to note how stakeholders' interests in compositions have been resolved in the face of MC=0. The American Society of Composers and Publishers (ASCAP) is a private association which bargains with users of copyrighted music. Their pricing system is designed to capture as much of the value created as possible by charging different prices to different users. Payments by television and radio users are related to receipts from advertising. The above mentioned case established the right to collect royalties from hotels using copyrighted music, and hotels are charged by a formula related to their total expense for entertainment of any kind. Symphony orchestras pay according to the aggregate salaries of the orchestra members and conductor. (Finkelstein, 1966 and Allan, et,al.,1968, p. 967). Note that the same large, well paid orchestras do not pay more than poor orchestras for a given quality of musical instruments. These pricing policies have implicit government approval since ASCAP could not use them without government acquiescence in a 1941 anti-trust decree. It is useful to note that on the international side, ASCAP (and its motion picture equivalent) bargain for rates which are finally subject to compulsory arbitration (Homet, 1984, p. 15).

Stakeholders are conflicting over home recording of music from radio. Producers get more revenue from records plus radio royalties than from denying use by radio. But, since the advent of cheap home recording from radio, producers claim lost sales. They fear that these substitutes for pre-recorded records and tapes will cause a reduction in revenues below costs of production and therefore threaten the supply of the material to be broadcast. This is an empirical question in some dispute (see Yankelovich, Skelly and White, 1982). If total revenues exceed production costs, producers would like to capture extra profit and home recorders would like it considered fair use.

Cable TV is another example of a MC=0 transformation of original material (content) from one media to another. The additional use over cable does not add to the cost of producing the original broadcast signal or its content. The lead case was United Artists Television Inc. v. Fortnightly

Corp. (392 U.S. 390, 1968) which found that cable operators did not infringe copyrights. The Court reasoned from an interpretation of what constitutes a "performance" and whether CATV was a viewer or broadcaster. This again misses the essential character of the MC=0 situation. Arguments over definition are really policy arguments over who gets to capture values created by a new use (transformation) of content in a different new media where these new uses add nothing to the original cost of the content.

Later, Congress established a Copyright Royalty Tribunal to set royalty rates. Congress compelled owners of copyrighted program material to issue licenses so that bargaining for permission was denied. The copyright owners were to get some of the extra value created (in royalties) but not as much as they could have obtained from market bargaining. Congress and the Courts let an infant CATV industry pay only marginal cost (zero with no permission required) and then later let it be charged more than marginal cost (administratively determined royalties).

The use of data bases is also a case of MC=0. The transformation of content from a printed data base to electronic form usable by a computer adds an additional use without increasing the cost of producing the content data. For example, there is a company which collects, publishes and sells advertising rate data. Another firm takes this data and puts it on a computer data base and sells it without paying royalties. In this case, the buyer of the electronically expressed data may have been former buyers of the printed version, as the two products substitute for each other. To date, the courts seem to have a different attitude toward transformations of so called creative works such as novels than toward assemblers of facts, though the investment required for the latter may greatly exceed the former.

The loan and rental of copyrighted material allows additional users of a given physical expression of a work. The cost of producing a book, record, tape or video cassette used by one individual or rented serially to many is the same (MC=0). At one time, publishers charged more to public libraries than to individuals under the guise of giving libraries a so called library binding. It is common now for scientific journal publishers to charge more to libraries than to individuals. Where these practices are regarded as legitimate, they are largely self enforcing and libraries do not try to get around the differentiated price by asking staff to pretend to be individual subscribers and then deliver their copy to the library.

Producers of movies on video tape are lobbying for some means to collect an extra charge for tapes used for rental. Movie tape producers could negotiate for some part of rental revenues (in effect charge more for a tape sold to a retail firm for rent than for sale to a consumer). Such a sales contract is now prohibited by law (first sales doctrine). If rental firms are competitive, there is no existing profit to be caputred by the tape producer. If the producers get more, the rental firm and its customers would have to pay more.

Note that price differentiation to rental firms is rare. Auto manufacturers do not charge more to car rental firms than to individuals. In fact, because of their market power, the rental firms get a discount. Firms which rent equipment to home owners do not pay more than anyone else for these items. Would this equipment be sold for less to individual consumers if the producers could price differentiate and charge more to rental firms? This is the equivalent to what is claimed by some pre-recorded video tape producers.

Movie producers who sell to broadcast TV networks are apparently recovering their costs in movie houses and TV sales. Still, they would also like to charge the person who uses their VCR to record the broadcast TV movie (even if the content is a situation of MC=0). This was the issue in the recent Betamax case. The Court ruled that taping from broadcast TV was a structure of fair use. In effect, the Court decided that video producers were already earning a reasonable return and accepted this performance.

Non-optional MC=0 Goods. Some goods while costing no more for another use or user may have negative value for some people. If the good is optional and easily avoided, there is not conflict. But, if the good is non-optional, there must be rules addressed to whether the good can be produced when its production for one person means involuntary consumption for another. An illustration is the cultural intrusion of broadcast TV from one country to another. The country which wants to avoid the intrusion would like to reduce the broadcast range or at least be compensated for the nuisance.

Implication for Investment Duplication. There is a further issue raised by the situation of MC=0 interdependence. If another use or user can be accommodated with no additional cost, it means that if additional investment is made and plant is built to provide for another use or user, it is duplicative and adds to total cost of production.

For example, if a TV cable is hung to serve a particular geographical area, the marginal cost of serving an additional household within that area is very low. If a second cable is strung in the same area to serve some of the customers (the market is divided) the total investment to serve all of the customers in the area is doubled, thus necessitating higher fees. This creates a conflict. Competition from several producers would keep price down to the cost of production (no excess profit), but the duplication causes cost to be higher than necessary to serve the customers. If there is only one firm, however, it may be necessary for the government to regulate rates. Some stakeholders prefer the lowest possible costs, while others would be willing to pay more to avoid the necessity for another regulatory agency. The issue of investment duplication is in addition to the question of differential pricing discussed above and also illustrated by CATV.

The higher cost involved in duplicative production facilities when there is MC=0 is also illustrated in data bases. The firm which now in a sense copies assembled and printed advertising rates (content) for electronic distribution (medium) could have collected its own data. But, this second collection of data by the new firm is unnecessary to service additional users via a new medium. The media are different and produce added utility at added media cost, but the content is the same and is MC=0.

The Houston School District has their own programmers producing programs equivalent to those already commercially available because the sellers won't give them enough discount for multiple copies (OTA, 1984). The extra programming resources don't produce anything that was not already available. Here, arguments ovar the price differentiation policies associated with MC=0 goods mean that duplication occurs and the lowest possible production cost is not achieved.

Summary of MC=0 Situation, Structure, Performance. To summarize a number of the above illustrations of MC=0, stakeholders can be categorized into four groups (realizing there are many sub-categories in some cases): content creators, distributors of this content via one medium, distributors via another medium, and consumers. Some of the above examples are noted in Table 1.

Content creators have something in common whether they be authors, playwrights, composers, performers, or movie producers. They, together with the distributors of their product via a given medium (whether book, script, record, TV signal or pre-recorded tape), compose a situation whereby a new transformation of that content into new media adds nothing to the cost of producing the original content (MC=0). The new media firms whether translator, hotel loud speaker system, live performer, CATV firm, or tape rental store would like to use the old content in the new media and pay only the zero marginal cost, while hopefully more than covering their own media costs in sales to consumers. The consumer in turn would like to capture all of the extra value of the content of the new media and pay only the extra production costs along the way. The remaining consumers of the content via the old media however, would prefer not to pay all of the fixed cost of the content, but rather share it with new media users. Public choice of allowable structural rules controlling pricing policy (right to charge different prices to different kinds of users, including different media users) affect performance measured in terms of the development of these new media and the effective purchasing power of a consumer's income. The structural rules such as fair use and the first sales doctrine affect the welfare of conflicting stakeholders made interdependent

Transformation sequence	Book	Music	TV	Pre-recorded TV tape	Play	Music
Content creator	Author	Composer	Author-team	Studio	Playwright	Composer. Performer
Distributor	Publisher (1)	Publisher	Broadcast	Theatre. Tape sold	Theatre	Recording
Transformation	Translation Publisher (2)	Live performance	CATV	Rental of tape	Movie	Hotel loud speaker
Consumer	Reader	Orchestra. Listener	Viewer	Viewer in theatre. Viewer at home.	Viewer	Listener

Table 1. Categories of Stakeholders With Similar Interests in MC=0 Goods Involving Media Transformations

by the MC=0 character of the situation. The SSP framework is summarized in Table 2 below. The Table can suggest how alternative property rights structures interact with the given situation to produce a different performance for the various stakeholders; but it must omit details relevant to each application.

Situation	Structure	Performance
MC=0	Pricing Rules 1. Fair Use	New media encouraged and consumer pays less.
	2. New use must obtain permission in market.	Content creator gains.
	3. Administrative pricing, e.g. Copyright Royalty Tribunal	New medium firm pays only MC.
MC=0 Durable goods with rental	a. First Sales Doctrine	Rental store and consumer pay less.
	b. Contracts are negotiated.	Pay more.

Table 2. Situation, Structure, and Performance of MC=0

6. Transaction Costs

Contractual. The cost of reaching agreements with other parties affects interdependence. For example, even when factor ownership says that a composer controls her composition, it is costly to contract and bargain with each radio station. An organization such as ASCAP reduces transaction costs so they do not overwhelm the value of the product itself. Rules, including anti-trust, affect the ability of private organizations to offset contractual costs. On the other hand, some possible contracts are prohibited as a matter of public policy.

It is attractive in principle to say that authorization should be obtained from the owner of each bit of copyrighted information which another person uses. However, as uses and assemblages become more complex, the negotiation costs may be overwhelming. As Solomon (1984) notes, "The locus of creation has become fuzzy in the machine age. Works may be created virtually anywhere, by machines or people; synthesized in other locations; created in multiple locations simultaneously; presented, 'read' or utilized similarly in multiple locations; and other complex and variable permutations presented by intelligent, distributed networks of computers." This presents significant costs of finding and negotiation among authors, and as noted below, it also makes attribution of marginal products difficult.

Transaction costs are also significant in an interest group's ability to affect decisions . An individual may own a nominal property right, but if costs of court action are high, it may prevent the seeking of redress for infringement. Those seeking changes in rights may find court, administrative, and legislative action to be substitutes. Different groups will find that economic power expressed in the market (based on existing rights) is sufficient (i.e. based on making or withholding purchases) while others may use voice and prestige to express demands while still others have less costs by using political power (giving and withholding votes and contributions).

Informational. When parties face differential costs of acquiring information, it can affect interdependence and performance. Issues arise here concerning consumer rights. For example, is the seller required to disclose information that would affect the buyer's decision if known? An illustration might be known bugs in computer software. The setting of product standards can save consumers search time. Even if the information is published, the consumer may have difficulty interpreting it. Such a consumer might prefer a product standard to assure quality and save information costs in making product comparisons. But, other consumers with lower information costs and higher skills may object to product uniformity and prefer more flexible variety.

Information cost can be a barrier to obtaining compensation for intellectual property and the consequences of these costs are affected by public policy. In order for ASCAP to collect a royalty for music played over the air it must determine how much copyrighted music is being played. And, to allocate the royalties to composers, it must determine whose music is being played. This is done by sampling stations' programming. The success of the system in reducing information costs to a manageable level depends on the legality and willingness of the parties to accept the approximate results. If the stations could be trusted to reveal their own records, the costs would be even lower.

Congress passed HR 4103 in 1984 which specified that receivers of TV signals via satellite dishes (earth stations) must pay a "reasonable fee" for copyrighted programs. The information costs to make a collection system work, however, are substantial. Block (1984) notes that "To demand payment from a user, program owners must prove that the user actually snatched and watched a program. Short of staking out the farmhouse with electronic eavesdropping equipment and then storming it with a search warrant, how can program owners prove a farmer ripped them off?" The transaction costs would be much less if the government sanctioned a surcharge (tax) on the manufacture of the dish. (This same solution has been proposed to collect royalties for material video taped from the airways.) There could also be considerable transaction costs in the allocation of the royalties from dish users. Agreement would have to be reached among the studio that made the movie, the pay channel that licensed it, the syndication company with aftermarket rights, the satellite company and perhaps the cable operator.

Information costs are often formidable in obtaining permission to use data from many sources for a data bank. The assembler may be willing to recognize copyright, but the project may fail because the copyright owners can't be found.

7. Input Complementarity

In some production processes, a unit of output can't be traced to variation in a particular input. Production is rather the result of several complementary inputs in relatively fixed proportions (in contrast to inputs which are substitutes for each other). As Burns (1985) puts it, "The complexity of our information constructions have led us to author-teams....We no longer live in a world where the most important information is created by individuals...." Thus, if there was a policy objective to assign rights or payment based on marginal product of the individual components, it could not be implemented.

For example, participants in computer based conferencing may embellish an original work. Dordick (1984) asks whether "these are new editions or new works?" and "are the financial rewards shared and how?" These may be quite different questions. First, in terms of sharing among the participants in the conference, it may not be possible to attribute any quantity of the result to any particular input. If all of these participants had been employees of the same firm, they would have been paid according to prior contract. If different skills are involved, there are often customs which set relative wages (for example of programmers and technicians). If the participants get more than their opportunity cost, it is determined by custom and policy containing an implicit distributive objective. Any return above opportunity cost is not necessary to attract resources. If the group is specially formed, members may agree to donate any result to the public domain. The costs of negotiating shares if no custom prevails may well prevent groups from forming.

The question of whether the embellishment is a new work has already been addressed under the heading of marginal cost equal zero. But if cost is not the basis of payment (or rights) and instead a value added concept is desired, the same problem described above as between the several embellishment participants can apply as between the embellisher and the author of the original work if they are complements. The original work may have been non-functional and can't stand alone and thus the old and the new are complements.

People's attitudes towards rights contenders is sometimes cost based and sometimes value added based. The rules of competition are generally designed to force prices down to costs. Yet, in some areas people seem to find it just to reward authors on the basis of letting them capture all of the value added (marginal product). The point here is that the character of the production process may make one or the other (or both) reward principle hard to implement.

8. Combinations of Categories

A given situation of interdependence may combine more than one of the above categories of situation. This has already been suggested, but can be further illustrated. For example, with a standard computer operating system, the marginal cost of fitting an application program to an additional brand of hardware is zero. Thus, the operating system controls access to the work of independent application program writers and non-standardization makes their work less valuable. Copyright thus can give much more profit to operating system owners (who are first and not necessarily best) than the same rights do for application programs. The same right has a different effect when the character of the interdependence differs (Schmid, 1985). The point is illustrated by the recent case of Digidyne Corp. v. Data General Corp. (81-4628, 4667, 9th Cir., June 7, 1984). Data General refused to license their operating system except to those buying its hardware. This was held unlawful under the Sherman and Clayton Acts. Copyright of operating systems was held to be a presumption of economic power. Ordinarily, there are many substitutes for a copyrighted article, but since a cosmetically different, but popular, operating system controls access to application programs written for it, it conveys market power. This point was apparently not raised in Apple Computer Inc. v. Franklin Computer Corp. (714 Fed. Rep. 2nd 1240, 1983) which regarded operating and application programs as the same type of good and situation.

In the face of high exclusion cost leading to unauthorized use of software, developers favor public education. The developers might be asked in turn if they would favor a developer education program relative to the pricing issue raised above in the discussion of marginal cost. Both involve learned standards of behavior where the environment otherwise permits wide latitude (you can stick it to the other guy). Software users suggest that their copying behavior is influenced by whether they think they are being treated fairly where sellers have discretion.

Some software makers argue that if sellers don't do some differential pricing for multiple copies by the same user, it encourages unauthorized high exclusion cost copying. Take the case of a person offering computer training who teaches 20 students on 10 machines. One spreadsheet program maker would offer 10 copies at 40% off. Should it be allowed to also charge profitable firms more than break-even firms?

Copiers often excuse their behavior by noting that the producer can afford a few lost sales. There may be some Robinhood philosophy in many people, but this should be probed to see if the copier feels justified because developers are rich or because they are using a flat price in the face of declining unit costs to extract what is perceived as unfair rents by buyers. Would the users feel different if software makers used rents from profitable lines to provide products whose prices couldn't cover costs? This is an alternative to using differential pricing for the same product to different kinds of users.

Several of the situational categories have to do with competition. A person with a given product faces potential competition from at least three sources. First are those who produce similar but allegedly different content. This was discussed in terms of factor ownership determining product space. Another source of competition is from the market practices of firms who can legitimately produce the same or similar products, but who use market power unfairly. Here the rules of competition (e.g. anti-trust) affect pricing policy. A third source is from alternative media which do not claim original content, but insist on paying only its marginal cost when applied to the new medium. Here such rules as fair use constitute a pricing policy.

The computer software industry is vociferously attacking consumer copiers (suing major corporations) and trying to find technological fixes to their high exclusion cost problem. But, there is another source of competition that in the future may be more threatening than duplicates. This comes from competing software manufacturers with near substitutes. Now, popular programs sell for several hundred dollars which makes duplication by users worthwhile. It also makes independent creation worth while and since there is no broad product space (see above section 1) around a copyrighted program, near substitutes of a slightly different expression are crowding in. Pournelle (1984) predicts that prices will fall sharply in the future and user copying will be insignificant at the lower prices.

If the performance objective is to increase the rate of return to present "authors", rights will have to be altered not only to get around high exclusion cost copies by consumers, but also to alter the basic distinction between an idea and its expression which defines product space in the face of incompatible use goods. If you don't know the multiple sources of stakeholder interdependence, you may achieve effective rights in one area, but lose ground in another. You may eliminate one stakeholder only to be exposed to another.

D. Summary and Conclusion

The framework offered here suggests that the relationships between stakeholders derive from the situational characteristic of the goods that the stakeholders create, distribute and use. These situational characteristics shape how one party's actions can affect another. The opportunities of each party are established by the structure of property rights. These rights influence outcomes or performance by specifying what actions are open to each of the conflicting parties.

The framework can be utilized by policy analysts and policy makers is several ways. First, it is way to organize experience. A type of informational good or service can be classified as to its situational category. Then if a certain rights structure (public policy) was applied to it in the past, the performance associated with it can be recorded. This performance can be in terms of how the interests of different groups were served by the rights structure. This paper illustrates the recording of experience with respect to a number of different kinds of information and media, but is not meant to be complete in terms of items or detail.

The next step is to utilize the recorded experience to suggest policy alternatives and to predict the consequences of those policies. It should be possible to classify a given good as to its situation and the kinds of opportunities that one person has to affect the welfare of another. The classification suggests first of all the kinds of rights and policies that are instrumental in affecting performance given that kind of situation. It suggests where to look for the relevant policy instruments. These rights alternatives can then be specified in more detail. Then if enough recorded experience is available, it should be possible to predict the performance associated with each rights structure. Thus, one has an array of policy alternatives and their expected performances.

Alternatively, if policy makers have a specific performance in mind relative to a given type of good, it is possible to place it in its situational category and identify the structural right that should obtain it. In other words, if a stakeholder is specified, it should be possible to identify the rights structure that will further that interest.

One of the problems in predicting the performance of a change in rights is when it has never been tried before. Nevertheless, it may be possible that the type of right in question has been tried with another good in the same situational category. While the goods are nominally different they may create the same kind of interdependence among the stakeholders, and thus the direction of the performance may be indicated when the same kind of policy is applied to other members of the situational category.

In the case of the incompatible use good situation, the interdependence of the stakeholders is controlled by factor ownership such a copyright. The big problem is to define the product space of the protected information. If it is defined broadly, the creator of the information will enjoy large returns if the information is in demand. Competitors will be frustrated even where they have been independently creative themselves. If product space is defined narrowly, the creator may not recover the costs of production. The issue might be summarized by asking how different does a potential substitute have to be to to avoid the protected product space? Or, in short, how different is different? If policy makers wish to specify a target rate of return for creative effort, the product space can be defined accordingly. In practice, the product space gets defined on some other conceptual basis and the rate of return gets determined willy nilly with unpredicted differences among products.

One may own a copyright, but if the good to which it applies is a high exclusion cost good, the right may be empty. The information creators will need something more than copyright. They will need the right to bundle the high exclusion cost good with other goods with low exclusion cost that can be sold in the market; some kind of learned habits internalized into users so that they will not be opportunistic in such activities as making copies; or government collection of a tax in lieu of royalties. Each of these structural rights alternatives impacts differently on the opportunities of competitors and users.

The value of information to a user is not independent of the number of other users. There is a situation of demand interdependence which is controlled by various rights allowing information to be distributed to only a chosen few or required to be shared broadly.

Goods which are examples of the situation of economies of scale create the opportunity for sellers to charge a different price to different users. Each group of users wants to only be charged the declining marginal cost rather than to share in paying the fixed costs. The right to use differential pricing affects returns to the providers of informational products and also affects the welfare of buyers. One's real income is a function of the prices that one faces. The other major policy issue with respect to this situation of economies of scale are rules which affect the realization of product standardization. Failure to achieve standardization affects the price that users pay.

The situation of marginal cost equal zero goods is an extreme version of economies of scale. As such it involves some of the same conflicts and is controlled by some of the same kinds of rights. The key structural variable is rights to practice price differentiation. One of the common conflicts over information involves the transformation of content from one technological medium to another. These transformations usually add nothing to the cost of producing the content. Conflicts among "authors", distributors via one medium, distributors via a second medium, and consumers are settled by the pricing policies implicit in such rules as the fair use doctrine and the first sales doctrine. These rules tend to either keep returns close to the costs of production or allow some parties to earn rents.

Still other goods are marked by high transaction costs either in consumating a trade or in obtaining the information necessary to act wisely. The impact of these costs is controlled by rules which prohibit or allow group contracting, affect the cost of access to the courts, or give consumers product information.

Finally, there is the situation of input complementarity. Where production is the result of teamwork and several complementary inputs in relatively fixed proportions, a policy objective of assigning rights or payment based on the marginal contribution (product) of each input can not be implemented. The conflict among the various input suppliers is often settled less by reference to formal rights than by custom.

It should be emphasized that a given informational good can have more than one situational feature. The effect of a given rights structure may be different with different situational combinations.

In conclusion, the above conceptual framework provides a receptacle for organizing the observations to be collected by OTA. As it stands, it suggests some of the sources of interdependence (stakeholder conflicts) in the production and use of intellectual property. While a major concern of intellectual property policy has been to protect creative work, the framework suggests that there are other critical issues which affect what is created in the first place. The realization of economies of scale (and thus minimal product costs), the utility of what is created, product evolution, and the formation of standards of compatibility are also important.

Table 3. FRAMEWORK SUMMARY: ILLUSTRATED

Situation	Structure	Performance
1. Incompatible use	a. Copyright and product space	Availability of substitutes
2. Exclusion costs	a. Tie-in sales allowed	Return to "authors". Unwilling riders pay for advertising.
	b. Learned ethic	Opportunity to copy is foregone.
	c. Governemnt tax	Unwilling rider.
	d. Market	Low returns
3. Demand	a. Information regulations	Affects what is secret
	b. Census rules	All have access
4. Economies of scale	a. Pricing policy	Relative prices
	b. Standardization	Lower prices to consumer
5. MC=0	a. Pricing Policy	
	No price differentiation.	Lower prices
	Price diff. allowed.	Rents to "authors"
	b. First sales doctrine	Consumer gains
	c. Fair use doctrine	Consumer gains
6. Transaction Costs:		
Contracting	a. Group contracting, e.g. ASCAP	Higher return to composer
	b. Court procedures	Access to courts
Information	a. Consumer protection	Better consumer decisions
7. Input complementarity	a. Wage structure customs	Relative wages of team members

BIBLIOGRAPHY

Allan, S., *et*. *al*. 1968. New Technology and the Law of Copyright: Reprography and Computers. *UCLA Law Review* 15:993-1028.

Arrow, K.J. 1962. Economic Welfare and the Allocation of Resources for Invention, in *The rate and Direction of Inventive Activity: Economic and Social Factors*, National Bureau Committee for Economic Research, eds. Princeton: Princeton University Press.

Battin, P. 1984. The Electronic Library--A Vision For The Future, *EDUCOM Bulletin*, Summer:12-17.

Baumgarten, J.A. 1984. Legal Approaches To Software Protection: Current and Proposed, *Workshop on Protection of Computer Systems and Software*. Washington: National Science Foundation.

Block, A.B. 1984. An Eye In The Sky, *Forbes*, November: 196 ff.

Bowman, W.S. 1973. *Patent and Antitrust Law, A Legal and Economic Appraisal*. Chicago: University of Chicago Press.

Breyer, S. 1970. The Uneasy Case for Copyright: A Study of Copyright in Books, Photcopies and Computer Programs, *Harvard Law Review* 84:281-361.

Burns, C. 1985. *The Economics of Information*, contract report prepared for the Office of Technology Assessment, Washington.

Bush, G.P. 1972. *Technology and Copyright*. Mt. Airy: Lomand Systems, Inc.

Columbia University. 1984. *Conference on Rivalry Among Video Transmission Media: Assessment and Implications*. New York, April 13-15

Dordick, H.S. 1984. *Intellectual Property: Protecting Rights and Priveleges In An Electronic Age*, contract report prepared for the Office of Technology Assesment, Washington.

Finkelstein, 1966. ASCAP As An Example of the Clearing House System in Operation, *Copyright Society Bulletin* 14 (2).

Geller, H. 1983. Television and Legal Problems in the Decade of the '80's, in *Law and the Television of the 80's*, R. Taylor, ed. New York: Oceana Publications.

Hebert, F. and W. Noel. 1982. *Copyright and Library Materials for the Handicapped*. Munchen: K.G. Saur.

Homet, R.S. 1984. *New Technologies and Intellectual Property Rights: The International Dimension*, contract report prepared for the Office of Technolgy Assessment, Washington.

Jehoram, H.C., ed. 1977. *Copyright Contracts*. Amsterdam: Sijthoff, Alphen aan den Rijn.

Jones, J.G. 1972. Community Antenna Television v. Copyrights Rights, An Unresolved Controversy, in G.P. Bush, *supra*.

Kinter, E.W. and J.L. Lahr. 1975. *An Intellectual Property Law Primer*. New York: MacMillan.

Levin, H.J. 1971. *The Invisable Resource, Use and Regulation of the Radio Specturm*. Baltimore: The Johns Hopkins Press.

MacPherson, A.H. 1982. Patents and the Semiconductor Industry, in *Patenting of Life Forms*, D.W. Plant *et. al*., eds. Banbury Report 10. Cold Spring Harbor Laboratory.

Office of Technology Assessment. 1984. *Advisory Panel Meeting*, Communication and Information Technologies Propgram, Intellectual Property in an Age of Electronics and Information. Washington, Aug. 29.

Pournelle, G. 1984. Of Publishers and Pirates, Popular Computing, 4(2):59-62.

Rubin, C. and K. Strehlo. 1984. Why So Many Computers Look Like the IBM Standard, Personal Computing, 8(3):52 ff.

Schmid, A.A. 1978. Property, Power, and Public Choice. New York: Praeger.

----------. 1985. Intellectual Property Rights in Bio-Technology and Computer Technology, Zeitschrift fur die gesamte Staatswissenschaft, 141.

Solomon, R. 1984. Intellectual Property and the New Computer Based Media, contract report prepared for the Office of Technology Assessment, Washington.

Tracy, E.J. 1984. Selling Software On The Honor System, Fortune, October 15:146.

Valenti, J. 1983. Open The Marketplace and Let The Competition In, testimony before the Sub-Committee on Patents, Copyrights and Trademarks of the Senate Judiciary Committee, Washington, April 29.

Yankelovich, Skelly and White, Inc. 1982. Why Americans Tape.

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INTELLECTUAL PROPERTY: PROTECTING RIGHTS AND PRIVILEGES IN AN ELECTRONIC AGE

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INTELLECTUAL PROPERTY: PROTECTING RIGHTS AND PRIVILEGES IN AN ELECTRONIC AGE

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I. CREATIVITY IN THE MARKETPLACE: A NEW SET OF PROBLEMS

The concept of intellectual property sits at the intersection of creativity and the marketplace. Creativity is that most difficult and ephemeral of human activities and in the industrialized West it must take its place in the economic market place where we spend most of our lives "getting and spending" in the words of Wordsworth (1).

The marriage of creativity and property has not always been an easy one; it is not one of those concepts readily supported by human behavior. Indeed, it is a marriage that is of relatively recent origin and not accepted throughout much of the world. The notion that the creator of a work is due certain rights and privileges because of this act of creation, rights and privileges from which the creator can derive economic benefits, appears to contradict the need for the work to be widely disseminated in order to establish its value to society. If society decides that the created work is valuable it will seek access that work by ethical as well as unethical means. Society is, in the late Ithiel de Sola Pool's words, "only moderately law abiding" (2).

A distinction between the creator of a work and the performer or presenter of that work is also of recent origin. The wandering minstrels of the middle ages were both creators and performers of their poetry, music and dance. Their "works" were rarely if ever written in a manner that could be interpreted by others and their art was passed on to successive generations orally and often through their children or selected bards and minstrels. Their creative works belonged to their community and imitation by other minstrels may very well have increased the value of their work as long as the reach of these imitators was limited to local villages or to the few stages in London playhouses. Today, these "performance cultures" can be found in the rural areas of developing nations, perhaps on the streets of urban ghettos in the industrialized nations and are, in a way, "market" in Bali (3).

The ethical issues embedded in the concept of intellectual property seems to have been founded on Jewish Law. The early prophets referred to the stealing of words from another. Jewish religious law forbade the "reporting of a thing in the name of him who said it" (4). Under Talmudic law reports who orally passed on principles of law from one generation to another were very careful not to express such principles without mentioning their author. Only when a reporter as scholar commenting on the biblical texts wrote an original passage that had not been said before, could that scholar use his own words. To this day the Talmud is printed in a form that clearly identifies the authors of the commentaries by their placement on the printed text.

Historians searching for the origins of copyright, the formal identification of a work of art with its author for the purpose of recognition and protection, have pointed to the classical Greek culture in the sixth century BC, with its development of an urban society with a commercial marketplace. They found that a "type of man appears on the scene who was hitherto practically unknown—the artist with a marketly individual personality" and the signing of works of art, poetry and prose (5). But there were no systems by which the artist could control its performance or display and, thereby lay claim to his output. There is no evidence that the artist wished to do more than reap psychic rewards, nor is it likely that these "artists-slaves" could expect more. The work was the property of the community or nation in which and for which it was produced.

The legal concept of intellectual property, indeed, the concept of creative works as property, seems to have emerged concurrently with the concept of property in the marketplace. When the printing press entered the industrializing world the notion that there was a connection between creative activity and monetary value, between an intellectual creation and the mercantile world emerged.

As long as the reach of a work was limited by the reach of its performer and the labor of those who made copies of the work there was no need to protect the intellectual property. Facilities for copying were limited, indeed, the copyists could be monitored and the paper and ink they needed rationed and otherwise controlled. The printing press reduced the cost of making copies, and increased the reach of the created work. The mercantile world of urban centers recognized that information was a product, a product that could be bought and sold in printed form, a product that was valuable to some people who were willing to pay for that information. (Information as an economic product is, clearly, not a new concept!)

Probably the first ruling concerning intellectual property may be the case of the monk Columba who was accused of stealing by copying the Abbot Finnan's Book of

Psalms (6). Recognizing this proclivity for copying useful information, the University of Paris protected those who dealt with existing manuscripts and the stationers who acquired these manuscripts, made copies and distributed them, in short, published works (7). The early years following Gutenberg's introduction of the moveable type press saw the rapid spread of printing throughout Europe requiring relatively large investments by printers in their equipment and in training their apprentices. Printers were also bookbinders and booksellers and they created and encouraged the creation of markets for their products. It was not long before there was competition among printers, binders and sellers or book publishers and "publishing and piracy appeared almost simultaneously".(8)

Publishing is a production process composed of a sequence of many steps. It requires the application of machinery and skill and takes time. It is a system that is amenable to monitoring and control. Consequently, the government could respond to the complaints of the printers by offering protection in the form of privileges. Government appointed "the Crown's Printers" seeking to do away with the "free lance" presses which published "pirated" material. The system of publishing allowed for the introduction of practices for the enforcement of the author's and publisher's rights.

Western societies generally respected these rights or privileges; creative people should be able to take economic advantages of their creative skills, should be able to earn a reasonable income from their risk taking, if their products capture a place in the information marketplace. And despite ethical lapses, the forms by which these societies have chosen to regulate the flow of information and to reward the creators of original works have stood the test of time. Copyright, patents, trademark, fair trade laws and trade secret protection have all served to encourage creativity through the protection of the creator's rights to rewards while providing access to these ideas for the public. The dilemma faced by policy makers is to reward creativity without penalizing society, to encourage the creation of intellectual property while not discouraging the publics' access to these properties.

Several forces have emerged in recent years that have made the enforcement of the rights and privileges due to the creators and/or publishers of intellectual property most difficult. This has resulted in an erosion of respect for these rights and privileges. Electronic production and reproduction technologies are greatly responsible or blurring the distinctions between the various steps in the property production process and are making it increasingly difficult to identify appropriate and effective points of control or bottlenecks in the process where enforcement can take place. Modern telecommunications greatly expands the product distribution and dissemination modes and channels making it extremely difficult to monitor access to the product. Information technology increases ease of access to information products which is favorable to users but creates enforcement problems for those seeking rewards for their creative work. These information technologies make covert access easier, tempting the ethics of even the most moral users. Artificially intelligent computers, the so-called Fifty Generation computers, may be machines that can create works, thereby seriously challenging the very definitions of creativity and authorship.

The rapid introduction of new technology often increase societal inequities over the short term. In both industrialized and developing nations there are groups that are economically and socially unserved and who fear a growing information gap between them and the information rich. While such a gap has always existed, today's promotion of the "information era" hightens their awareness and fears. Consequently, they feel that information of value to them should be available to them at no cost, that information benefitting society should be made public regardless of how it was produced and by whom. This attitude is especially prevalent in some developing societies where the Western concept of intellectual property may be unknown or defined in ways that are different from the Anglo-American definitions. Where discrimination may exist due to selective access to information one is likely to find serious pressures for obtaining intellectual property by means that are outside the normal channels. As these "normal" channels are being radically altered by the new technologies, societal pressures are by-passing the enforcement procedures, and eroding the privileges granted to the creators of intellectual property.

The highly promoted notion that we have entered an information society has greatly increased our awareness that information is an economic product, has always been an economic product and has value in the marketplace. The cost of merchandising information is raising the price of information, thereby often increasing the perceived value of that information. Consequently there are pressures to obtain information at reduced costs, either ethically or unethically, either through the established distribution channels or through alternate channels. As we noted these channels are increasing, as are the means for the production and reproduction of information or creative works. With greater ease of by-passing these channels and doing so covertly in order to save money, enforcement practices are losing their effectiveness. Satellites, trans-oceanic cables, high frequency radio transmissions, international data networks are circling the globe, interconnecting nations to each other in ways that are extremely difficult to monitor. This international distribution of intellectual property makes it clear that ideas do not hew to national boundaries, neither do intellectual properties. The electronic dissemination and distribution technologies that have created an international information business by their very nature weaken the property protection practices. It is, therefore, necessary to create a mechanism for rewarding creativity that rationalizes the many concepts of intellectual property that may exist across different societies.

In this paper we explore the impact of the electronic information technologies on the practices for protecting the rights and privileges granted to the creators of intellectual property. Technology is not the only factor weakening today's practices for enforcing intellectual property laws; economic, social and cultural changes in our society and throughout the world are equally important. Our tasks are:

To develop a means for identifying and characterizing the technologies that are likely to enhance or diminish rewards for creativity and enhance or diminish opportunities for access to intellectual property,

To use these identifiers to determine how present and future technologies are likely to enhance or diminish rewards and access to intellectual property,

To suggest a taxonomy with which to examine the economic and social impacts of emerging electronic technologies on the purposes for which the protection of intellectual property is performed, including concepts of intellectual property that are likely to emerge in the future, and

To suggest additional issues that merit further examination.

II. CHANGING DEFINITIONS

Discussion of intellectual property protection generally focus on that form of protection that has been most widely used, copyright. In the next section we shall see that protective screens are, today, being sought from other laws such as those dealing with patents and trademarks. The reason for this broadening of the protective umbrella is that the definition of just what is copyrightable is under siege, indeed, becoming terribly blurred as the information technologies for production and reproduction, and for dissemination and distribution become more widely used while the perceived value of the information created increases.

We shall discuss these changing definitions under the four categories found in the copyright provision; Works, Author, Publisher and Publication, and Performer and

Performance. In the following discussion, we shall introduce the questions arising from the use of the electronic information and communications technologies that are creating difficulties of interpretation.

Works are usually defined as intellectual creations in the fields of literature, music, art and science. The work must be in a concrete form of expression, that is, not merely communicable in the moment of its presentation as an unrecorded or spontaneous performance. In short, it must have a tangible form of expression.

The work must be original but need not be novelty or unique; the merit of the work with respect to its originality or intrinsic value is immaterial to its copyrightability.

An aspect of this definition which has become of special relevance to computer software is the issue of copyrightability of the expression of an idea rather than the idea itself. "The Pygmalion theme or an explanation of how to build a radio receiver cannot be monopolized through copyright protection, the particular play or article which expresses the idea is protected" (9).

The definition of works in the U.S. Copyright Act of 1976 traditionally includes:

Literary works;

Musical works, including accompanying words;

Dramatic works, including accompanying music;

Pantomines and choreographic works;

Pictorial, graphic and sculptural works;

Motion pictures and other audio-visual works; and

Sound recordings.

Absent from this listing are the new "works" made possible by the electronic information technologies: computer software, both application and operating.

Information on an application software disk may not be considered as having a tangible form of expression until it is "read" by devices in a computer and presented to a reader on a screen or on a printed page. If the information on the disk is transferred or "read" into the random access memory of the computer in order to be accessed during some processing activity, can this be considered as having a form of tangible expression? (10)

Information embodied in a machine's operating software never does see the "light of day" for it is internal to the computer and is the information that manages and organizes the complex operations of the computer. What is the tangibility of this software product? Can the object code of the operating software be copyrighted even if it does not appear in any form that can be used by a human, and is used to organize and manage computer operations for the user. In Apple Computer Inc. v. Franklin Computer Corporation the Third Circuit Court held that the object code can be copyrighted and rejected the argument that copyrightability "depends on a communicative function to individuals." (11)

Computer firmware, both application and operating.

Program information can be permanently embedded in semiconductor devices or chips. Indeed, there is considerable evidence that in the future major personal computer firms will seek to capture a greater share of the software market by chips copyrightable as works or might they now be classified as patentable products? Are they mere "machine parts" and therefore not copyrightable as the Third Circuit Court ruled in Apple v. Franklin.

The design of the "chip" represents the information contained in the firmware. Is chip architecture, design, configuration or topography information that can be copyrighted even if the chips they define represent "machine parts?" It is difficult, but not impossible, to "reverse engineer" a chip design, that is work backwards from the chip design to its photolithograph, alter one or more pathways and argue that a new design or expression of the underlying idea has been developed.

The many word processing and spread sheet programs that became available in the wake of the personal computer "boom" raises the aforementioned distinction between the underlying idea of a work and its expression. The underlying idea is of creating text by computer; there are many ways of expressing this underlying idea. But, if a particular program can be shown to represent the "only means of expression of its underlying idea," the distinction between ideas and expression may become increasingly important in the future. (12)

While the courts have generally held that software is copyrightable, clearly one can develop several interesting arguments challenging this ruling on definitional grounds. We expect continuing debates concerning copyright as the application and operating software becomes more important to business and industry and, consequently, more highly valued information products.

Videotex and teletext representations require the configuration of information into "frames" for coding and presentation on the screen so that readers are attracted to the information. While the information is what is being sold, how it is represented is crucial to its marketability. The market value of teletext and videotex information is both in the information and its representation or "frame." Are the frames works and their designs copyrightable? Or is the information and its frame only copyrightable together, as music and associated words or words and associated music are copyrightable.

Pool describes a scenario for the future that challenges the traditional concept of copyright on still other grounds. Consider the possibility that a work, say a scientific report, is in the tangible form of a computer disk, stored in a database accessible via a computer-communications network. Payment to the author could be made on the basis of the number of times the work is accessed; users can be identified and charged by means of their access codes and passwords. But purchasers of the work can easily make numerous copies of that work, distributing these copies to colleagues, students and friends. Clearly, this is quite similar to lending a book to a friend or many friends; a facet of print copyright we cannot and do not control. But copying works on to computer disks is so much easier and the author is likely to lose considerable revenue, especially if it is a textbook or scientific article that students and scholars wish to keep for future reference. The author, consequently, decides to periodically upgrade the original "manuscript" in order to maintain its scholarly as well as economic value. While the work is in a tangible form it appears to be ephemeral; changes can be introduced rapidly and continuously. Is this work copyrightable within current rules that require a tangible product? (13)

It is possible for "readers" of the book or paper to easily make additions to any version of the work commenting on it as did the ancient Talmudic scholars on the bible, embellishing the original product and claim a copyright for that embellishment. Participants in computer based conferencing often find opportunities to embellish an original work and, depending on how they perceive the value of their embellishment claim copyright protection. Are these new editions or new "works?" Who owns the copyright? Who has the first authorship, the original rights to what version of the work? Are financial rewards shared and how? Indeed, who is the author and what is the "work?"

Technological means can very likely be developed to embed in the original version of the work a date of first authorship, a code which cannot be tempered with. Additionally, a program could be written that would permanently identify when the user (purchaser) accessed the document. We have learned, however, that if one attaches a high value to the information, one will spend the time to unlock even the most cleverly implanted codes. The solution to these problems are not, however, likely to be technical; rather a combination of appropriate pricing and some institutional arrangements will convince the potential lawbreaker-codebreaker-"hacker" that it is not worth the time to steal the information.

Defining the author, the originator of a work and presumably the main beneficiary of intellectual property protection is becoming quite difficult. In Anglo-American law the author may be a physical person or a legal entity. Authors are usually defined as natural persons or individuals who may transfer by contract his/her economic rights for purposes of obtaining publication and distribution of their intellectual products. But their ethical rights to authorship remain with them.

The traditional and increasingly rare type of author is the individual who, unaided, produces a finished product, the writer who with paper and pen or with a typewriter (often an old mechanical one) produces a literary work, the painter who produces a canvas and the composer who produces a musical score. There have always been difficulties defining the author who has created a sort of matrix or outline for the work and leaves it to apprentices for its execution. Hence, we will often find large canvasses credited to the atelier of Ruebens and other old masters.

With scientific research increasingly requiring facilities and financing only major firms can provide, and with the complex nature of much of today's research not only in the sciences but in business as well, multiple authors supported by corporations or governments are very common. Rewards are shared among these multiple authors. Authorship may be assigned to a corporation for whom the authors work. Works requiring the creative talents of many participants, films, for example, which call upon script writers for scenario and dialogue, composers for music and a director are financed by large organizations, major studios or advertisers. Economic benefits resulting from copyright protection are granted to the studio or agency for appropriate distribution, but artistic recognition, the psychic rewards, are for the creative participants.

Computers can be "made intelligent" through the development of programs that simulate experts. (10) Expert systems will be capable of creating "works" that today require authors. Early on we can certainly expect that programs will be developed to abstract and possibly translate works. The argument can be made that these are not original works since they are derived from original copyrighted material. But will the operators and/or programmers of the computer demand a share in the economic as well as psychic benefits to which the first author is entitled?

It may be difficult to define an author when the intermediary is a computer that has been programmed to abstract papers for a journal, to create bibliographies, to translate from one language to another or the create computer-based data libraries for machine access from original material. These computer created ouputs create serious definitional problems for both "works" and "authors."

Science fiction had long ago dreamed of a machine that can create an original work without the assistance of several monkeys locked in a room with typewriters over many many years. The question of what constitutes authorship is likely to be more difficult to unravel as the Fifth Generation Computers arrive on the scene. The more elusive the definition of "work," the more difficult the definition of "author."

Publishing is the production and distribution of works. What is publishing and who is the publisher are readily defineable when the work is embodied in the tangible form of a book. The publishing process is a sequential one; there are more or less fixed steps in the process. Similarly, the book distribution process is also well defined by the bookshops and book counters in stores and shopping centers. Worldwide control of distribution is maintained by publishing houses through their branches and warehouses. Consequently, it is easier to create bottlenecks where monitoring can take place and to identify lawbreakers.

Publication of sound and video recordings occur when the records and tapes are issued to the public. Similarly a film is published when it is offered for sale or rental to the public. Recitals and performances by live actors do not constitute publication, although it is necessary to obtain the right for the performance of the work.

However, when there are multiple channels for distributing published works, monitoring the distribution process becomes more difficult. And with that the definition of just what is publication and just who is the publisher becomes equally difficult. When the property has taken a form that makes it inexpensive and relatively easy to reproduce, in short, when it has been transformed into an electronic product, control of the publication process may be impossible.

Consider the multiplicity of channels available for the distribution of a videocassette or an audio cassette. In addition to the standard radio and television broadcast channels that make up the traditional modes of distribution, there has been a veritable explosion of telecommunications facilities that has created a dense network for the distribution of films, csasettes, audio and video. These networks include cable televison, satellite, the many new "non-broadcast" terrestial channels such as multi-point distribution (MDS), single and multiple channel, instructional television fixed services (ITFS) for educational and non-profit institutions, the new Low Power Television stations, and the single sideband FM radio transmission facilities. With advances in telephone technology, leading to the integrated digital network in one form or another, we must add the telephone network, both wired and via radio as cellular mobile radio, to a growing list of distribution technologies.

When a video or audio program is re-transmitted for cable television, or any other non-traditional distribution modes enumerated above, does this constitute publication and is consent for this re-transmission necessary as has been argued by Henry Geller, former Assistant Secretary for Telecommunications and Information at the Department of Commerce. (14) Clearly acquiring this consent from the originators of the works or their agents will result in additional payments for re-transmission. But with the vast array of distribution networks, how can one discover if unauthorized re-transmission has taken place? There are just too many nodes to monitor and, further, too rapid a transmission in order to control distribution.

In addition, audio and video products are distributed world-wide via satellite and cable networks. Products that are purchased for distribution to foreign cinema theaters may be copied at remote locations and pirated for showing cinema houses that have not paid for the rights and to videocassette shops for sale or rental to the wider public. There is an increasingly complex and rich matrix of interconnected transmission networks throughout the world that makes monitoring most difficult. Nevertheless, when the product is highly valued, as a film production from a major Hollywood studio is likely to be, attempts are made to selectively monitor cinemas and other display and presentation points in order to capture film and cassette pirates.

In the United States controlling the distribution of video products through the "public airways" by enforcing complaints against "pirates " who have purchased and installed increasingly low cost receive-only equipment may be contrary to the nation's communication policy. The airways are public, it is argued, and therefore satellite transmitted signals, as well as terrestrially based MDS signals are as open to reception as are the signals transmitted by traditional broadcast stations. Encryption of broadcast signals raises the cost of program distribution which must be borne by subscribers who pay for these services.

Piracy in the distribution process is not limited to audio and video products. Computer-communications networks provide a multiplicity of channels for the distribution of works on computer disks. The topology of these networks and their connectivity make monitoring well nigh impossible, even if one could break into the digital language to reclaim the original formats.

What, then, constitutes publication? If we cannot define the publisher nor what publication means in this emerging era of multiple networks, how can rewards due the creators of intellectual property be determined and payed?

Finally, the copyright provisions define the concepts of performance and performer. Performance covers both the original performance and the performance of a copy of a work. Protecting works includes the protection of its performance, otherwise the value of the monopoly privilege extended to the author would be seriously reduced. However, these dual rights vary considerably throughout the world. As pointed out by Ploman and Hamilton (15), in one international convention the two concepts are linked in that protection is provided for the performers for their performance, the rights of broadcasters for their broadcasts and the rights of record producers in their records.

When works are electronic rather than print, these distinctions become blurred. What rewards are due to the artist whose recorded performance is re-transmitted numerous times over cable and other channels at the same time it is "originally" being distributed via the broadcast network? What rewards are due to the artists whose performances are captured on videocassette and sold and rented through video shops? This issue has been the subject of recent actions by Screen Actors, Directors and Writer's Guilds in the United States with the consequences that changes in royalty arrangements have been made to reward performers for multiple duplication/distribution of their performances.

There is a close relationship between what constitutes publication and performance of works. Difficulties being created by the new electronic technologies for defining the former will make definitions of the latter more difficult.

III. RIGHTS OR PRIVILEGES ATTACHED TO THESE PROPERTIES

Despite this nation's long held distaste for monopoly in all its forms, and our inherent belief that monopoly is detrimental to our society, we have provided what are essentially monopoly privileges to the creators of intellectual property. "...in the Anglo-American legal tradition neither copyright nor patents are inherent rights." (16) In our society knowledge and information generally flow freely and can be used by anyone. We do not charge people for reading books they have borrowed from others or who read them aloud to others and we do not collect royalties from people who watch a television show or listen to music on the radio or play a borrowed record or tape. It is not practical to do so and it is not in our tradition to do so.

However, we have created certain laws that govern intellectual property, laws that essentially give monopoly privileges to the creators of intellectual property for some period of time. As Pool pointed out what the grantee gets is not a matter of rights but rather of public policy to give protection for a period of time under certain circumstances. (17) We determine the conditions of the privilege in terms of our market economy, that is, it is necessary for the protected property to have some unique market position that is not easily duplicated by others before the state will enhance this position by granting copyright, patents, trademark and other forms of protection for intellectual property.

We have created five procedures for enforcing the privileges granted to intellectual property:

Copyright is a government created property right (but not government granted) giving the owner some exclusive rights in publishing and reproducing the works created; it gives the creator uses of that work by others. (18)

While a copyrighted subject need only be original, a patented product must represent a novelty and an improvement over prior art. (19) A patent is granted by the government through the U.S. Patent and Trademark Office in the Department of Commerce while copyright is administered by the U.S. Copyright Office in the Library of Congress which registers claims and records transfers and licenses of rights that have claimed copyright upon its creation, and have been granted copyright protection. The Copyright Royalty Tribunal an independent agency in the legislative branch deals with the proper allocation and distribution of royalties payable when licenses for use of copyrighted material are negotiated and granted. This distinction between copyright and patent is becoming quite important today as computer software producers explore the means to protect what can be a work, a process, or a product in the form of firmware.

A trademark is a word, letter, sound, symbol, device or some combination of these that is used in connection with a product or some merchandise to distinctly identify that product. The use of a person's image such as that of a well known actor or actress (John Wayne and Elizabeth Taylor, for example) for advertising products with which the persons represented by these images are associated has raised the question of ownership of a property known as personal image. (20)

Trade Secret Protection has been relied upon quite heavily by equipment manufacturers to deal with equipment privacy. Computer software and video producers have recently sought to contain piracy through the use of these laws. In an industry where there is considerable employee mobility and which, it is argued, mobility in both Silicon Valley and Route 128 may be significantly responsible for the success of the firms, it is difficult to prevent disclosure of information by former employees (21).

The Fair Trade Laws and other means of protection under the law of unfair competition have also been brought to bear in attempts to maintain the protection of intellectual property. These procedures have generally been used in cases of firm to firm confrontations, such as against the pirating of equipment as well as of customers and clients. But the blurring of the distinctions between product and process and the emergence of firms that produce information in the form of processes and products have encouraged the use of these laws in today's intellectual property disputes as well.

Authors have moral rights and are given monopoly privileges that have monetary values. These moral rights include their right to "object to unauthorized distortions of their work and to claim authorship credit when their work is reproduced." (22) These rights are recognized in European copyright systems and are protected. But in the US copyright tradition, only the pecuniary rights or the monopoly privileges to the author by the copyright are enforced. Baumgarten, (23) however, referring to W. Strauss, (U.S. Copr L Rev Study No. 4, U.S. Government Printing Office, Washington, D.C., 1959) says that under legal doctorines including the laws pertaining to unfair competition and defamation, the moral rights of authors can be protected in the United States.

We are concerned here with the rights that are protectable by laws and for which enforcement procedures have, in the past, been suitable but which now are challenged because of the new electronic information technologies. It is, of course, to be expected that new applications of these technologies will emerge in future years and that these applications will create new challenges and difficulties for practices that are designed to protect intellectual property. Indeed, it may be impossible to protect intellectual property as we have in the past and that to continue to encourage the production of creative works while not impairing access to these works, new policies will be required. To prepare for this future it is preferable to discuss the characteristics of electronic information technologies and how they are likely to impact the privileges or rights we believe are important for stimulating creativity rather than focus on the systems equipment themselves.

To assist us in developing a means for identifying and characterizing the technologies that are likely to enhance or diminish rewards for creativity or diminish or enhance opportunities for access to intellectual property we shall bundle the four definitions and their rights or privileges into two;

1) The rights and privileges granted to the creator, individual or legal entity, that require protection for the work product itself, or those that are derived from the legal definitions of "author" and "work" as discussed above, and

2) The right and privileges granted to the creator, individual or legal entity, that require protection of the dissemination of that work, or those that are derived from the legal definitions of publishing and performance, discussed above.

IV. CHARACTERISTICS OF ELECTRONIC INFORMATION TECHNOLOGIES LIKE TO IMPACT POLICIES FOR PROTECTING INTELLECTUAL PROPERTY

Characteristics Affecting the Work Product Itself

We are concerned with providing the author control over the production of the work, its reproduction or copying and its alteration or modification with the author's consent. We want to prevent or minimize unauthorized reproduction, access to, translations of, abstracting, modifications of and listing in one form or another in bibliographic data bases.

Technologies that will affect the enforcement of any rules for protecting these rights are likely to have the characteristics shown in Table I.

Books and magazines have always represented the most tangible form of intellectual product, or hardware. When displayed in bookshops, on book stalls and magazine racks, they are easily identifiable, counted, kept track of. In warehouses they are taxed as inventory. They must be read by people who hold them in their hands and even after "consumption" maintain their tangibility.

Electromagnetic transmissions, on the other hadn, represent the least tangible form of product, primarily because they cannot be seen (while in transit) or held in one's hand and yet represent an intellectual product. It is even less tangible than information in RAMS AND ROMS, for this information can, at least be said to reside in a computer.

The ease with which it is possible to reproduce the work product ranging from relatively difficult to very easy as shown in Table I.

Refering to Table I (h) reproducing a book or magazine, page by page, requires time and effort; it is piece-work requiring some expenditure of labor and a relatively expensive piece of equipment. Similar efforts are required to reproduce or copy film by means of photographic techniques, or an acoustical recording. But once information is electronically packaged, that is in the form of electrical information either analog or digital, copying is relatively easy and rapid. Re-transmission of a product via broadcast means simply requires assigning a new carrier frequency to the information signal and increasing its power for retransmisson. Once having invested in the equipment to do so it is easy to repeat the process.

The cost of reproducing a work product, once having obtained the necessary equipment ranging from the relatively high cost to relatively low cost as shown in Table I.

TABLE I

CHARACTERISTICS AFFECTING THE WORK PRODUCT

(a) Degree of Tangibility	(b) Ease of Reproduction	(c) Cost of Reproduction	(d) Degree of Covertness
High	Difficult	High	Low Risk
Books and Magazines,	Physical reproduction of pages in a magazine or book,	Reproduction or copying of a book or magazine page by page,	Copying the contents of a personal computer RAM or ROM
Films,	Copying a film by means of photographic techniques,	Reproduction of a film using photographic techniques,	Copying the contents and transmitting it to another location via a network
Acetate Recordings,	Copying a film into an electronic form,	Reproduction of audio and video magnetic cassettes,	Reproduction of audio and video cassettes
Video Cassettes,	Copying a recording using acoustical means,	Reproduction of electronic version of a film,	Reproduction of films, either to another film or to a videocassette
Audio Cassettes,	Copying a video cassette, audio cassette by means of electromagnetic or electrostatic techniques,	Reproduction of the information on a computer disk or other hard storage device,	Translating a transmitted broadcast
Computer disks and other hard storage device,	Reproducing the information on a computer disk or other hard storage device,	Copying the contents of a RAM or a ROM	Reproduction of a book or magazine
	Reproducing the contents of the RAM on to a ROM or to another RAM or to a printer or a screen for reading,	Translating a transmitted broadcast	
Low	Easy	Low	High Risk

There is always an initial cost for the equipment required for making copies of works. Once having made this investment, the cost per copy is a function of the material and the labor required to perform the copying tasks. While the device for copying computer readable information is more expensive than a device for making copies of printed material, the labor and material costs involved for copying books and magazines are often considerably higher than similar costs for copying computer readable information products. (Refer to Table I (c))

The degree of covertness with which such reproductions can be made or the risk one takes to do so ranging from lowest risk (or a high degree of covertness) to the highest risk (lowest degree of covertness). (Refer to Table I (d)) The information mode used will have some impact on the degree of covertness or the risk. Thus, for example, the information content of digital material may be more difficult to detect than that of analog material. Hence the relative low risk in computer driven reproductions as shown below.

With the availability of personal computers, copying computer readable products in the privacy of one's home provides the highest degree of covertness as illustrated in Table I (d). But with the appearance of small personal copiers, this same degree of covertness may be available for copying books and magazines. However, the book copies are still tangible and do not resemble the original, hence can be exposed. The reproduced computer disk is in everyway identical to the original disk from which the copy was made.

Protection of the work product from unauthorized abstracting, translations, modification and bibliographic listings is made difficult by the intangibility of computer created work products in its external and internal memory systems, the rapidity with which these "copies" can be made for ephemeral presentations on cathode ray screens or for printing on low cost dot matrix printers in homes and offices. Once having invested in the equipment, such copying is easy and very low cost, (the cost of a disk and negligible labor cost). Word processing application programs make embellishments of the versions of work products simple for the serious "author" and in the future probably equally simple for the amateur as applications programs become easier to use.

For networked computers, especially desk top or personal computers, it is becoming easier to transmit copies of work products, programs as well as articles or books that may, in the future, be written for computer reading. This presents an entirely new concept of an intellectual property, perhaps entirely impossible to deal with in the normal terms of property. A product designed for "computer reading" is, today, a software product. Many argue that it is impossible to design enforcement mechanisms to protect software, that any technological fix will be overcome by hardworking "computer hackers." Many programs give the purchaser the right (or license) to make a "back-up-copy" of a valuable piece of software, for the sole use of the purchaser, a task which the computer user finds both educational and simple. Ten back-up copies are as easy as one. If one gives these copies to friends or students to enhance their work, is this fair use. And how can the author determine if these copies have been given away as gifts or sold? And what difference does it make to the author, the author is losing royalties from the gifts or the sales.

Pool (22) argues that technological fixes are inadequate and that some form of social organization must be created to reduce the desirability of software copying. But more this elsewhere.

Characteristics Affecting the Distribution, Dissemination and Exhibition of the Work Product

Turning now to the protection of those rights and privileges granted to the author or legal representative or entity for preventing the unauthorized distribution and dissemination of works and the unauthorized performance or presentation of these works. This includes the unauthorized broadcasting and other audio-visual presentations or communication of works such as recordings. These are the rights discussed previously as Publication and Performance.

Laws for the protection of intellectual property must walk the fine line between creating rewards for the originators of the works while not creating prohibitive access barriers for the public. It would, of course, make little sense to use distribution modes that are so limiting or restricting as to destroy the market for these works; no one would benefit. The nature of books and magazines defines a distribution system that is geographically broad while allowing for monitoring so that to a considerable extent, both the author's rewards from and the public's access to the property are more or less well balanced.

Electronic distribution of less tangible products create difficulties for the authors but increase access to the public; the respective needs of authors and public appear no longer to be balanced. In the following discussion of electronic and information technology characteristics, we focus on both access and covertness as measures of the degree to which these technologies have and will continue to impact how we must deal with the protection and distribution of intellectual property.

We now turn to the question of communication network architectures and how they either increase or decrease access and the degree of covertness they provide. (See Table II)

One-to-One Networks:

A computer-to-computer network, much as a switched telephone connection offers a minimum of access and a high degree of covertness. Works can be transmitted from one computer to another via the public switched telephone network or on a broadband cable network with impunity. Since the content is coded into bits

TABLE II

CHARACTERISTICS AFFECTING DISTRIBUTION, DISSEMINATION, AND EXHIBITION OF A WORK PRODUCT

Degree of Covertness	Network Architecture	Geographical Distribution of Network	Transmission Technology
Low Risk ↑	One-to-One	Personal	Time Division Multiplexing
	Many-to-One	Local Area	
	One-to-Many	Regional	Pulse Code Modulation
	Few-to-Many	National	Frequency Divison Multiplexing
↓ High Risk	Many-to-Many	International	

and, indeed, may be encrypted, determning if unauthorized distribution is taking place is extremely difficult. Audio-video images can also be transmitted via the telephone in the form of freeze-frame transmission and "tapping" the line to determine if an authorized transmission is taking place is somewhat easier. However, legal authority to perform such tapping is required and often necessitates long delays to obtain permission.

One-to-Many Networks:

Broadcasting and over the cable re-transmission of broadcasting greatly increases access to the property and does allow for monitoring and discovery of unauthorized transmissions. Indeed, the film industry and its various guilds have set up a network of monitors throughout the world to insure that the very high valued films in which so many people have large stakes are adequately protected and that rights for dissemination and preformance are paid for as the law requires.

Many-to-One Networks:

A bibliographic computer accessed data base by which many can gain access to a large block of information is an example of a many-to-one network. As noted in the previous section authors often have little control of such listings and how their works are referenced on these data base and if abstracts are provided often cannot control their content. Furthermore, unless special provisions are taken to control access, such as requiring a subscription fee and access codes before access and an access fee authors will receive little or no rewards for the use of their works. The more complex the "sign-on" procedures the more difficult the access. However, this cannot control the copying of the document, unless the technical options previously noted are feasible.

Many-to-Many Networks:

Computer conferencing, audio and audio-video conferencing are examples of these networks. These can be wire, cable or over the air transmissions. On the wired networks, access can be controlled by various sign-on and switching procedures. When private, there can conceivably be the unauthorized distribution and presentation of protected works. When these networks are between or within firms, the cost of discovery may be high enough to discourage illegal entry. But when these networks are between private users, as on computer conferencing networks, there is less incentive for obtaining permission for distribution and presentation of copyrighted materials. (The number of participants on these networks can vary indeed, in its early history cable television touted its potential for providing community-to-community communications, an example of few-to-few network.)

Closely related to the network architecture is the geographical distribution of the network. The public telephone switched neywork (PSTN) is not a single network; it is a network of more than 1500 telephone systems. Within these systems there have been a large number of private networks, networks capable of providing services customized for specific applications and firms. Prior to the 1984 divestiture of AT&T the number of such private networks in the United States were said to be in excess of 3000. At present this number is rapidly being doubled.

An additional consequence of the divestiture is the emergence of so-called by-pass networks, networks that do not use the PSTN at all. Wire, cable, earch-based microwave, satellites, fixed and mobile communications are used in various mixes to provide transmission facilities. These networks can be nationwide or local, indeed personal: (See Table II)

Personal Networks:

The most local of local distribution networks may be found in the office or home. A variety of information machines can and, indeed, are usually interconnectee in an office and the professional home. These include personal computers, video-recorders, perhaps videotex terminals and, of course, the the telephone. They are, in effect, personal and private networks serving a limited geographical area in which unauthorized transmissions and copying of works can be done almost with impunity.

Local Area Networks:

Local area networks (LANs) may be considered to be expanded personal networks and usually interconnect word processors, electronic mail devices, video equipment and other information devices required for managing information. Through either a private network or the PSTN, these LAN's reach into the "outside" world. Local broadcast and cable systems are forms of local area networks using over-the-air rather than wired transmission. A number of additional local broadcast modes have emerged in the recent past, Satellite Master Antenna Television Systems and Low Power Television. What they have in common is the ability to deliver information products to small numbers of people and because of their limited geographical coverage could do so relatively covertly.

Regional Networks:

Local broadcast and cable television systems are often regional in scope. Low Power television, and the variety of multi-point distribution systems can deliver video quality or high speed data to regions. Over the PSTN and the private and by-pass wired networks, computers can rapidly transfer data. Hidden within the digital transmissions, either encrypted or not can be works for which distribution and presentation rights may not have been granted.

National and International Networks:

Computer networks via satellite, land based microwave and transoceanic cables circle the globe; international satellites distribute video products world-wide. Transborder media and data flows have already become issues of major interest to governments. Protection of personal privacy has been of concern to many and the inability of nations to control money flow seriously threatens state sovereignty. Modern telecommunications do not respect national boundaries and often do not respect intellectual property laws in the nations whose boundaries are being crossed. What constitutes intellectual property and the rights and privileges associated with the phrase varies from culture to culture, nation to nation. Superimposed on these differing notions of just how, if at all, intellectual property should be protected. On top of these varied notions are the global telecommunications technologies, becoming ever more flexible and transparent, making the task of protection extremely difficult.

The choice of transmission technology can protect property by making access difficult. However, the transmission technology chosen may lend itself to covert copying. (See Table II)

Frequency multiplexing is commonly used to send multiple transmissions on telephone lines and over the air. The signal is transmitted in analog form. To access a particular signal or message involves essentially "tuning" to that frequency, much as one tunes the radio and or selects a television channel. Analog information is readily reproducible and does not require decoding.

Time division multiplexing, on the other hand, requires that the analog signal be sampled in time, digitized and modulated on a pulse carrier. Decoding requires the ability to capture encoded information in time rather than in frequency. This is more difficult, requiring somewhat more complex equipment than the relatively simple mechanism one encounters in tuning a radio. In addition the digitally encoded information must be decoded for reconstruction into information that can be read.

It is difficult to readily determine from a time division multiplexed signal the content of the information being transmitted. Even with adequate equipment and skills, determining the sampling rate and coding of the transmitted information can be difficult. Hence, transmission of unauthorized products would be difficult to detect.

V. MATCHING TECHNOLOGIES TO CHARACTERISTICS TO ENFORCEMENT REQUIREMENTS

In this section we match the intellectual property enforcement requirements to technologies that affect enforcement. We match these technologies to the characteristics outlined in the previous section. We shall also review trends in technology developments that we believe will continue to affect the intellectual property laws of the United States as they are now written. We stress that we are matching technology to U.S. intellectual property enforcement practices; a similar analyses should be performed focusing on the intellectual property (or equivalent) enforcement practices of other nations. We would expect that significant differences in impact will be observed. In so far as modern telecommunications can create a one world of information, the development of effective and useful approaches to encouraging creative activities while not discouraging access to creative products must be carried out globally.

Technologies That Affect the Work Product Itself

XEROX has become the generic name for all makes of copiers. There is hardly an office in the land without at least one device that can rapidly, cheaply, and rather reliably copy printed documents. Even at the price of 7 cents per page a 300 page text book can be reproduced at the Xerox machine at less cost than it can usually be purchased, new and cloth bound in a bookstore. (Textbooks are rarely printed paperbound.) It is always assumed that labor is free! However, over the past several years some progress has been made in enforcing the limited copying rules of recent copyright decision. Several copying services have been taken to court and the threat of further lawsuits have caused librarians and offices that can monitor their xeroxing activities to control the practice.

But copying machines are becoming smaller and cheaper and are finding their way into the home and into the one-person offices where monitoring is expensive or impossible. We can expect this trend to continue and while these smaller less expensive machines do not give quality reproductions and are often trouble prone, the cost of the copying option may continue, under some circumstances, to be seen as preferable to purchasing an expensive textbook.

When the printed page is converted into an electronic page, into bits and bytes on a magnetic or optical disc or to a RAM in a computer, the copying process is virtually costless when compared with the purchse of an original. (It is assumed that the initial investment for the equipment to perform this copying has been made for reasons other than copying!) Similarly, when the information on the acetate film is converted into electronic information on a disc or tape or any other electrostatic or magnetic storage device, the cost of making additional prints from the original.

It is this shift from words, images, and music in tangible packages such as books, magazines, films, and records, to electronic impulses on RAMs or inexpensive magnetic discs or tapes that opens the gates to unauthorized reproductions of intellectual products and unauthorized dissemination and exhibition of these products.

Work Processing or Work Distribution and Exhibition?

The years since World War II have witnessed an explosion in the application of long known principles of physics and chemistry and the 18th and 19th century experiments of Babbage, Boole and the first programmer, Lady Lovelace. Today's expansion of telecommunications technology did not require new science and because much of what we need for further developments are out of the laboratory, we can with some considerable assurance forecast the telecommunications and computer technologies, what is not being called the information technologies, of the future.

The transistor and the remarkable photochemical processes that make possible the production of massive numbers of computer functions in very small volumes and at prices that always seem to be falling have been introduced into telecommunications equipment. This, and the subsequent redefinition of the telecommunications/computer equipment markets is referred to as the convergence of the computing and communicating technologies. The results of this marriage is seen in the many new varieties of communications systems, channels, equipments, and uses now in the marketplace.

It is increasingly difficult to differentiate between systems that compute or process information and systems that communicate information. To a considerable extent, therein lies the difficulties for systems that are designed for the protection of intellectual property. For a system that is used to process a work can also be the system by which this work is transmitted or disseminated.

Personal computers, the desk top microcomputers that may be in home or office are in the marketplace and while the early boom in the home is being replaced by their rapid entree into the office, these powerful tools are increasingly being used by creative writers as well as professionals who prepare reports, research documents and other information that has value. These personal computers may be operated stand-alone or, with the addition of a low cost modem, can communicate with other personal computers, indeed, other computers in general via the public switched telephone network, (PSTN).

Mini-computers formerly occupied the middle ground between the large main frames and the micro-computers are rapidly being replaced by the micro-computers in offices and also by Word Processors. Word Processors can be viewed as special purpose computers, the special purpose being the electronic typing of texts. These word processors may also be stand-alone or networked with other word processors, main frame computers, mini and micro-computers via the PSTN.

These devices not only can be used to create the work product, they can store that product within its own memory (storage being a form of copying as we have seen), can present the information on the cathode ray screen for reading, an intangible form of presentation or exhibition, or can deliver the contents of its memory to a printer. The intellectual product can also be transmitted one or more locations where a comparable piece of equipment is prepared to store the information for later display or printing. In effect, this amounts to publication!

Works can be stored in a large computer data base, an information store, for access by equipments that can then store the work for later use in its internal memory, or on a disk file, or can display the work for immediate reading or can print the work for more tangible storage. These information stores can be publicly accessible or accessible only if permission is given if the store is a private one. Fees could be paid by those requesting access and such fees can reflect whether the work is being read on line (a rather unlikely occurrence for large works) and for receiving the work for storage.

These information stores usually provide abstracting as well as translation services. With the emergency of expert systems and artificial intelligence, abstracting and translations may become standard practice on large bibliographic data services, as for example, those provided by Chemical Abstracts. The ease with which such "new works" can be created and distributed may require new definitions of work, author, and publishing and new systems for enforcing the author's rights and privileges for rewards.

There are several forms of stored information systems. Professional and business services, such as those of the aforementioned Chemical Abstracts, Lexus for lawyers, Medlars for physicians and the general purpose Dialog, store and provide access to information essentially by the word or digit. The searcher can request keyword, or key data searches across many files. An intelligent terminal is required and the searcher must usually be sufficiently skilled to remember codes, addresses, and work with often complex modes of inquiry.

Public data bases such as those to be developed for Videotex and Teletext services store information by the page for this is how most people search for and access information. A relatively simple search procedure and a modestly intelligent terminal, a telephone and a television set are all that is required to access Videotex and Teletext information page-by-page. Videotex is interactive via the PSTN or cable television system while Teletext information is broadcast, either over-the-air or via the cable and provides only a minimal search capability because it is not on-line. (While the cable can provide interactive capability, Teletext via cable is usually one-way and does not require the cable to have the upstream capability operable. If it were interactive, we would call it Videotex!)

To complete our listing of devices for receiving and copying or storing works, for immediate or later exhibition, there is the videocassette recorder.

There is, then, a wide range of devices for creating, accessing, storing or copying, and distributing works, once these works have been put into electronic form.

Perhaps the most important consequence of the converging of computing and communicating is th eimpact in transmission technologies. Primarily as a result of the increased use of microprocessors and other forms of semiconductor chips the cost of transmission is falling very rapidly. One might say that before too long the cost of transmission will be essentially zero; the cost of the communications will be in the information itself and the means for its input into and output from the transmission system. The reason lies in the ability to more efficiently use a transmission channel, an ability that derives directly from our ability to use time division multiplexing. To do so requires the ability to sample information and to code this information in ways that enables us to send many messages along a single channel. The more information we can send along that wire, radio spectrum, cable or optical fiber, the lower the cost of transmitting each message.

Digital tramsmission of voice, image, data and video over a single transmission path creates additional problems for monitoring the contents of that transmission path. Additionally, as we noted previously, the number of pathways for transmitting information is increasing. While the spectrum allocated to radio transmission (including television, of course) has not expanded, the ability to more efficiently use the assigned bands has resulted in the allocation of additional space for new services. Video transmission, and if we so desire, data as well as voice, transmission can take place via the standard broadcast channels, over the new microwave distribution channels known as multi-point distribution, over the new LPTV channels and via the direct broadcast satellite. Finally, the telephone and the radio spectrum have merged for the delivery of mobile communications services via cellular technology.

VI. RISKS, REWARDS AND ACCESS

The economics of intellectual property protection is a complex issue. How much should the nation spend to encourage creativity by means of providing a period of monopoly power to the creator of a work and how much will this cost society by being denied free access to that work?

What are the international trade consequences of limiting foreign access to intellectual property and what are the political consequences of such policies, considering the enforcement difficulties that one might encounter?

An analysis of these issues is beyond the scope of this paper. However, there are important finding that should be considered in any economic analysis that may follow.

There is every reason to expect that the systems and equipments we have described will become universally available; their cost will continue to fall as their performance improves. Indeed, in the not too distant future, we can expect that the nation's telephone networks will become sufficiently "intelligent" to allow one's telephone to have the ability to access data bases, process information received and deliver that information either to a screen for immediate reading or to a printer for later more deliberate study. Furthermore, it is highly likely that this intelligent telephone system will also be able to input information, create works for transmittal to others on the networks.

There is also every reason to expect that distribution systems will continue to expand its information carrying capacities, continue to deliver transmission at lower and lower costs and provide ingenious means for covertly delivering coded information wherever one wants this information delivered. A greater number of private networks, networks outside of the PSTN will proliferate, not only in the United States but throughout the world. With more powerful satellites in orbit, users will be able to access world-wide transmission systems from almost every place on earth. Dick Tracy's wrist-watch radio-TV will be a reality with some respectable computer power added for good measure.

Access to networks by information producing, reproducing and receiving devices will be almost universally available to those that are willing and can pay the price for the information sought.

The shape of our information society has not yet been revealed but there is every reason to believe that social equity will not be one of its gifts to the future. On the contrary, the high value that will be placed on information will result in high prices for information, for the intellectual products of the information era. To qualify for information work will require access to information, to the expensive intellectual products that represent the knowledge necessary to obtain information or knowledge equality. As more and more works become available in electronic form or as the cost of paper "xeroxing" continues to fall, the temptation to bypass the high cost of legal access can be expected to be high. Today's lack of respect in many Third World nations for the monopoly privileges granted to authors of the First World will be the rule rather than the exception.

VII. A SUGGESTION AND A MODEL FOR FURTHER STUDY

It is clear that intellectual property in an information era is a commodity on the world market. It is also quite clear that this world market is an electronic network marketplace, and that the properties to be bought and sold are in the form of bits and bytes and are capable of rapid and often covert transmission anywhere at anytime.

Whatever system is created to stimulate the creation of original works, whether these works be music, films, books, performances, scientific findings, computer programs, chip designs, robot instructions and whatever human ingenuity will invent in the future, this system must be acceptable as universally as is possible. In short, it must be a global system.

However, the concept of intellectual output as a property and the need for rewards to the creator of such output is not universally accepted by all nations throughout the world. One can readily point to the socialist countries where the concept of personal property is denied, at least officially, and where, consequently, rewards to approved(!) creative artists take the form of public subsidies. But there are many shades of gray between the practices in the socialist bloc and the practices in the Anglo-American tradition. Islamic nations have a different interpretation of intellectual property than does the PRC, and Taiwan. South Korea still another view. The struggling nations of Africa have still other notions of what their access to the West's knowledge base should be.

These concepts, the legal interpretations for these concepts, and the enforcement systems, if any, that are created to implement the legal interpretations will all be affected by the information technologies we have discussed. The consequences of these impact, however, are likely to be different for each legal interpretation and enforcement system. A global or as near to global system as is politically possible, must be created out of these varying consequences.

We suggest, therefore, further work structured as follows:

1. Research to identify the several substantial policies concerning intellectual property in the Socialist world, in the newly industrialized countries, (Taiwan, Singapore, India, South Korea, for example,) and in the developing nations, and, of course, reexamine the Anglo-American views on intellectual property.

2. Obtain or construct the legal structures that support these policies.

3. Determine and describe the enforcement system(s) and practices that have been established, if any, to support these policies.

4. Determine, as we have done in this paper, the consequences of the impacts of the new information technologies on these enforcement systems and practices.

5. Construct a taxonomy of consequences, and

6. Explore the possibilities for creating one or more uniform or adaptable and acceptable concepts or legal frameworks for intellectual property and determine what kind of enforcement systems and practices are appropriate.

We have not, in this paper, discussed as fully as is necessary the social, political, both domestic and international, and economic, domestic and international, consequences of the impact of the information technologies on intellectual property. Not only is this a prerequisite for further work in defining new enforcement systems for the US but must be a major task in the research proposed above.

FOOTNOTES

1. Sonnet by William Wordsworth beginning:
"The world is too much with us,
Getting and spending we lay waste our live..."

2. Ithiel de Sola Poo, "Whither Software Copyright" unpublished paper, prepared for Conference on "Critical Issues In Computerization Policy", East-West Center, Communications Institute, Honolulu, Hawaii 1983.

3. Miguel Covarrubiar, Island of Bali, Oxford University Press, London, 1977. In recent years musical works by John Cage and others noted for their aleatoric styles have been denied copyright protection because it is not possible for an artist other than the composer to perform the work, a modern version of composer-performer synthesis.

4. Ploman and Hamilton, Copyright, Routledge and Kegan Paul, pp. 6-7, London, 1980.

5. Ibid, p. 5.

6. George Haven Putnam, Books and Their Makers During the Middle Ages, 1476-1600, Vol. 1, Hillary House, New York, 1962.

7. Ploman and Hamilton, p. 8.

8. Ibid, p. 9.

9. Jon A. Baumgarten, "Copyrights" in Kirk-Othmer, Encyclopedia of Chemical Technology, Vol. 23, 3rd Edition, John Wiley and Sons, Inc., 1983.

10. For a discussion of how the computer performs these copying and reading tasks as well as of artificial intelligence, see paper in preparation by Richard Solomon for this project.

11. Apple Computers, Inc. v. Franklin Computer Corporation, 714 F. 2d 1240 (Third Circuit, August 20, 1983)

12. Ibid.

13. Ithiel de Sola Pool, Technologies of Freedom, Belknap Press of Harvard University Press, Cambridge, 1983, pp. 212-215.

14. Retransmission consent became a thorny issue when the importation of distant signals was seen as a source of profit for cable television systems. Under the "Passive Carrier Exemption" Rule, (Copyright Act, Section 111(a) (3) cable systems importing distant signals over which they had no control were not liable

14. (Continued)

for additional copyright payments. But when the Superstations emerged, the local television station that became a national station by means of satellite distribution, it was argued that the works created for that local station were now being made available to markets that were not in the original contract. The cable operators argued that if the superstation paid additional copyright fees for retransmission of programs and were to pass this on to the cable systems, the economic viability of the cable systems would be jeopardized. Geller has argued that some payment to program creators are fully justified.

15. Ploman and Hamilton, p. 36.

16. Pool, "Whither Software Copyright", ibid.

17. Ibid.

18. Baumgarten, Ibid.

19. Ibid.

20. Dave Vierra, "Images as Property: Legal and Ethical Problems Concerning Image Ownership", Ph.D dissertation in process unpublished, University of Southern California.

21. Everett Rogers and Judy Larsen, Silicon Valley Fever, Free Press, N.Y., 1984.

22. Ploman and Hamilton, p. 37.

23. Baumgarten, Ibid.

THE ECONOMICS OF INFORMATION

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I. THE CONCEPT OF INFORMATION

A. The Evolution of Ideas

1. Before the Book

From the beginning of civilization ideas and information have been held as valuable to the community, and authors have been encouraged to release their work to the public in return for recognition, encouragement and reward. Normally goods and services had tangible form and their price could be set in relationship to the cost of production. In the case of oral histories, entertaining tales, folk medicine and knowledge of the natural world, though, it was not easy to find an appropriate currency. This inherent struggle to find an economics of information was addressed in various ways:

- In 6th century Greece there emerged for the first time individuals who thought of themselves as "artists"; for the first time poets proclaimed themselves as authors and artists began to sign their work.[1]

- Jewish law has a long history of regulation concerning intellectual property. Early prophets spoke of "stealing" works from each other and later oral tradition required reporting a thing "in the name of him who said it." As Talmudic principles evolved, the permission of an author or his heirs was required before his work could be copied. Thus attribution was followed by the recognition of rights.[2]

- In 3rd century Sybarite Greece, chefs were entitled to "own" new recipes for a year and to enjoy exclusive rights to their use.[3]

- In 12th century Ireland the concept of rights to information was further extended. When a visiting monk copied his psalter without permission, Abbot Finian appealed to King Dermot who caused the unauthorized copy to be returned with the observation: "To every cow her calf, and to every book its copy."[4]

At the same time various restrictions came into practice which permitted information to be held exclusively:

- During the Ming Dynasty in 14th century China very specific rules proscribed the removal of any books from the library, and no person could enter a library alone.[5]

- In ancient Egypt, ritual incantations were the sacred property of the priesthood and anyone else heard reciting them could be immediately executed.[6]

- The Hippocratic Oath forbids sharing medical knowledge with persons outside the medical fraternity, a prohibition broken most notably by Galen, the 2nd century Greek physician who wrote many of the basic medical texts that carried Europe through the Middle Ages.[7]

- Technology such as alchemy, medicine, and even the art of typesetting was very closely guarded. Gutenberg died a pauper because of the law suits he fought to keep his secrets.[8]

Thus over the centuries those who had created information products asserted their right to control distribution. At the same time there were others in the community who were affected by the information and who felt that its distribution ought not to be determined entirely by the economics of personal property.

- Broader access to religious writings reduced the power of priests, and lead to the disintermediation of the church.

- The early efforts at theology also changed the faith itself: the widespread availability of scripture was key to provoking the reformation.[9]

- Scientific information was pouring out of the libraries of Constantinople and was viewed as "discovery". The natural philosophers were greatly honored, but ownership was never imagined.

2. The Product Compromise

A conflict existed between the individual's desire to control valuable information and the broader belief that the distribution of those ideas should be determined by society. A mechanism was necessary that would balance the author's requirements against the desires of the community, but two thousand years of experimentation had demonstrated eloquently that ideas, knowledge, expressions and insights were slippery commodities indeed.

Two ingredients were necessary for a stable exchange mechanism: (a) a definition had to be found to describe what the author was actually offering. Much of the early literature—Boccaccio, Chaucer, Cervantes and even Shakespeare—consisted of retelling old tales, so it was difficult from the outset to claim that the author was offering—or even claiming to own—ideas. (b) A rational basis for pricing had to be found. A single piece of information could have widely different value for different people so it couldn't be priced according to value. There was obviously no systematic relationship between value and the amount of labor expended to create the product—the poems of John Donne, treasures of our language, were written by a busy clergyman and circulated free among his friends.

WHY NOT ?

SO WHAT ?

In our reading of history, Renaissance Europe seems to have moved toward a a resolution of this difficult problem by allowing information to be treated more uniformly as a product. While recognizing that people authored "ideas," it settled on the more expedient notion that the author was offering an "expression". It moved away from the problem of putting a price on knowledge by bundling everything into the package, pricing the package in relationship to its manufacturing cost and permitting information to be bought and sold under the more widely understood rules of real property. And all along the way, this compromise set in place concepts of information economics which have served us faithfully for four hundred years.

NO! WORDSTAR
DOES NOT
SELL FOR
ITS MANUFACTURING
COSTS!

The evolution of information as a product did not come solely, in our opinion, as the result of a pressing need to reward authors—the fact is that nothing so characterized the Renaissance as a great burgeoning of authors, scientists, philosophers and artists who offered their thoughts to the public under a compensation scheme consisting mainly of patronage and university support. Instead, we believe that the copyright laws emerged as they did because of an alignment of interests, each of which was served by the new economics:

- The printers faced enormous investments in setting a book in type and saw in the product compromise a way of regulating the market so as to prevent the emergence of a competing text.

- The Church, struggling with science on one hand and the Reformation on the other, saw in the notion of information as a product the possibility of regaining some control over access to knowledge which had for centuries been its exclusive domain.[10]

- The state, made nervous by broadsides, criticisms and the sudden distribution of incompatible views, saw in market regulation the hope of censorship.

- At the same time the product compromise made no claim on ideas, and universities which were thriving on the rebirth of science and philosophy found that this simplified way of dealing with information served to encourage broader access and more systematic attribution without imposing any restrictions on teaching or intellectual invention.

- The standardization of Európean languages, brought on by the new printing industry, gave greater identity to expression: writings were quoted more and translated less loosely into the vernacular[11]

- The idea that information could be controlled by its author was strengthened by the philosophy of the time which Daniel Bell describes as a shift of rights from society to the individual, a shift of focus from arts to crafts and the rise of "technic":

> "Free movement of goods and money and individual and economic and social mobility became the ideal...In the culture we have the rise of the independent artist, released from church and priestly patron, writing and painting what pleases him rather than his sponsor; the market will make him free." [12]

The concept of the book as an information package provided more than a means for storage and distribution, it created a simple economics for the exchange of knowledge.

In the century that followed, the concept was embodied in laws of increasing specificity:

- Roman custom appears to have included the concept of intellectual property, supporting contracts between authors and publishers. [13]

- The first printing "privilege" or limited monopoly was awarded to Aldus Manutius in Venice in the late fifteenth century and the French equivalent was awarded in 1507.[14]

- Religious struggles in Elizabethan England led the crown to adopt a policy of censoring publications by awarding exclusive licenses—the so-called Star Chamber decrees of 1586 and 1637.[15]

- By 1709, civil war and the decline of licensing had battered the English publishing business. The license granted to the Stationers Company in 1557 was allowed to lapse and book piracy was common until the Statute of Queen Anne established the first clear concept of author's right to regulate the printing of his own works.[16]

- Between 1783 and 1786, twelve of the thirteen new American states passed copyright legislation, attributing to the author a number of rights, including the right to copy, translate and produce derivative works, forging another link between ideas and printing that resolved the ambiguity of information economics—at least for two hundred years. expression?

3. The Information Age

Today the product compromise is coming unglued.

Technology makes it easier to separate the expression from the package in which it was first offered—to copy an article without buying the magazine, to record a television program while zapping the commercials, to download portions of a database.

At the same time new information products and services permit us to separate the idea from the expression, repackage it and sell it in competition

with the original. Data compiled by one publisher is reorganized and sold by another. Abstracts of articles are sold in competition with the articles themselves and the cost of originally gathering and organizing the information is often never recovered.

EXPAND

These are commercial problems arising from the use of new technologies that were not anticipated in the sixteenth century, and while efforts have been made to cope with them on a case by case basis, it is clear that our conventional understanding of information identity, ownership and value is increasingly out of date.

Even our understanding of how information ought to shared seems to be under increasing strain:

- Daniel Bell argues that the rise of knowledge is creating a post-industrial society flooded with information in which political and economic power will go to those who can wield its secrets more effectively.[17]

- Harlan Cleveland suggests that information cannot be easily traded like a commodity or wielded by a few, and must inevitably be shared in a way that will challenge our concepts of "ownership" and even the structure of our society.[18]

- The National Telecommunications and Information Agency, responsible for our national policies on this matter, apparently believes that information should be shared with other nations, subject only to the restrictions imposed by national security and a respect for personal privacy.[19]

- The White House Conference on Libraries took an even broader position: Since a democratic society depends on informed citizens, objective, timely and reliable information should be available to everyone without charge.[20]

Together these views eloquently restate the case for sharing, but they also ignore the fact that not all information distribution is good: all societies have laws against libel, obscenity, fraud, and espionage, for example, and even the most ardent one-worlder scratches a boundary around his own privacy.

At the same time the information age seems to draw us toward higher and more complex mechanisms for secrecy:

- Information is big business. It may not be true as asserted that authors will cease to be creative below a certain level of compensation, but it is certainly true that businesses who organize, package and distribute information will turn to other pursuits if they cannot control the fruits of their investment in an orderly market.

- The ability to raise investment capital depends on the premise that some people become informed about potential value before others do. Just as the industrial age required concentrations of capital and the agricultural age required contiguous, protectable aggregations of land, much of our financial structure relies on information exclusivity, not on sharing. Gregory Bateson: "Information is the difference that makes a difference."[21]

- Information has become technology: The path from scientific knowledge to proprietary technology has become shorter and more direct. Biotechnology and the rules of artificial intelligence, for example, are routinely treated as secrets, and society concurs.[22]

Part of the contention between these views lies in confusing information with knowledge. Information is a means for capturing, transporting and expressing knowledge. We may argue that knowledge is revealed and that it may or may not come as the result of work, but information is a product or service born of investment which must be rewarded. Some information services need to be supported by the community—ringing the fire alarm, conducting and reporting elections, for example—and so, in a simple sense, they should be "free". As a practical matter, most knowledge is available without charge to anyone who will bear the cost of retrieving it. All non-restricted government information, all books and magazines and even many private research materials can be read at a library.

But if the reader wants a copy to take home he must bring his own pencil and paper, or put a dime in the photocopy machine, or buy a complete copy in a bookstore, or have it abstracted or translated. In each case he is spending a mix of his own time and assets to get a more appropriate information package.

Those who advocate more protection for information tend to be referring to products and services, not to knowledge. They are seeking to recover their investments in production, not to own ideas.

B. Defining Information

Any survey of the various definitions given for information reminds us of that most honest lexicographer, Humpty Dumpty: "When I use a word, it means just what I choose it to mean—neither more nor less." [23]

- Information is content: Fritz Machlup,[24] Daniel Bell[25] and others tend to use "information" and "knowledge" interchangeably, and focus their discussion on the content of information, not its form.

- Information is a science: Librarians use the term "information science" to describe the management of access to various information forms (books, films, online databases). "Information centers" are where the forms are maintained, and "information specialists" maintain them.

- Information is patterns: George Miller,[26] Paul Watzlawick[27] and others see information as "negative entropy"[28], patterns that can be distinguished from the random noise of nature.

- Information is communication: Claude Shannon,[29] Norbert Weiner[30] and others have focused on information as a set of symbols (markers) in a channel, and concerned themselves with the efficiency of the symbol set, the channel mechanism and the faculty for decoding meaning.

Information is content, stored and distributed over sometimes unique technologies ("information technologies"), and managed with sometimes unique procedures ("information systems"). When the results are exchanged in commerce they are called "information products" (manufactured before sale) and "information services" (manufactured after sale). The study of the integrity of the content as it is transported is called "information theory" while the practice of storing and retrieving information is called "information science."

The problem with this conventional understanding of the various terms is that they have arisen independently as a way for participants to identify themselves to each other and, while they serve that purpose well, the terms are less useful in helping parse the economics of information.

Consequently we propose a definition which is more descriptive than restrictive, that seeks to show the relationships between kinds of information and attempts to highlight differences that have economic significance.

1. The Purposeful Construction of Symbols

Information is a dimension of things, not a thing itself. While a book has a higher ratio of information to matter than, say, the cross section of a tree, both are informative. We are tempted to start: information is not a stone, yet time and again fossils have revealed the most complex secrets of our past. A few drops of blood make an articulate report on the body's condition and the color of the clouds at sunset tell a trustworthy tale about the condition of the atmosphere.

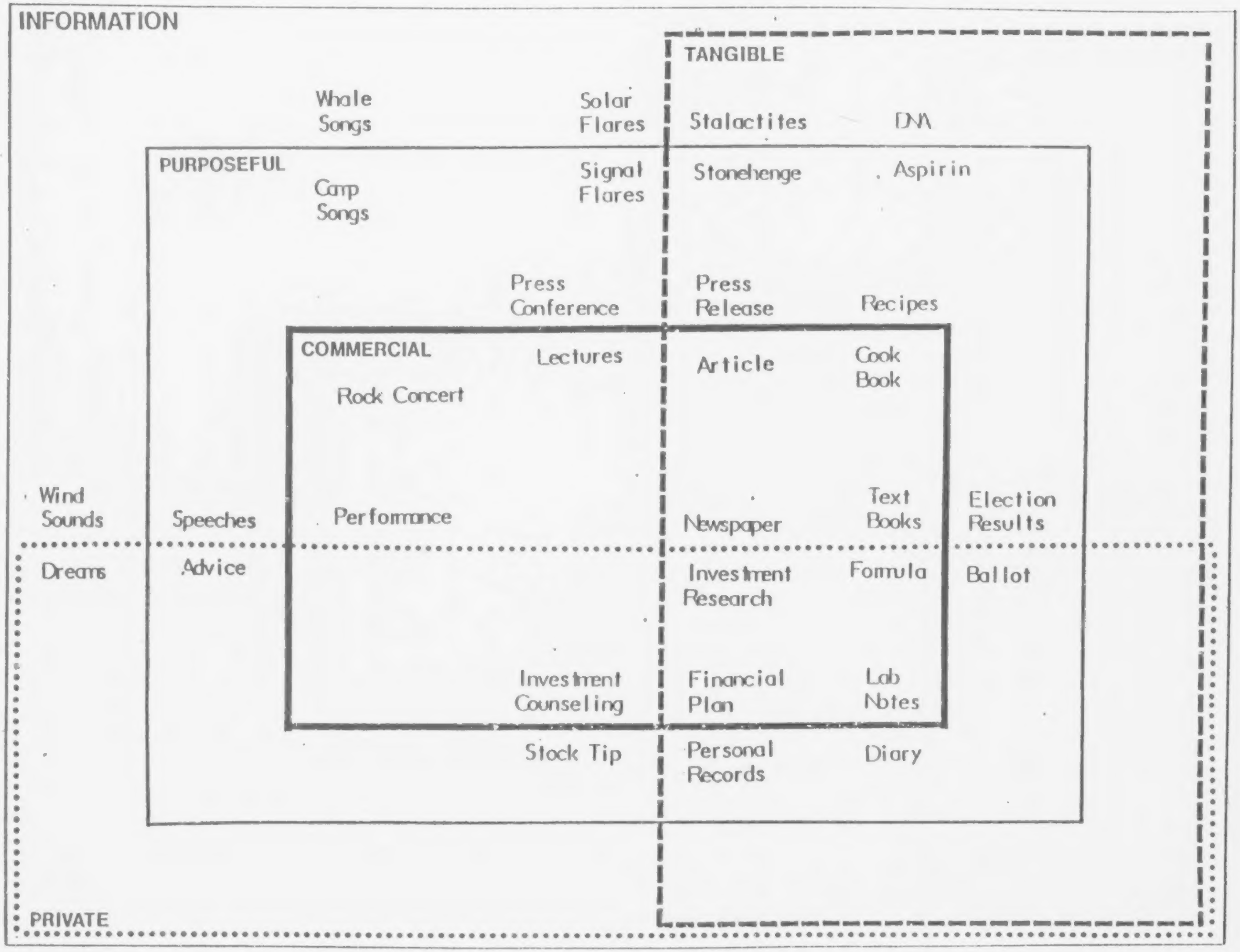
For the purpose of this research, though, we propose to focus attention on a subset of all information defined as the **purposeful construction of symbols**—this is closer to the common meaning of the word and provides a more useful structure for the discussion. The boundaries of the set are determined in three tests:

"Purposeful" implies an intelligent source—to avoid ambiguity we shall say that it implies a human source—whose actions in this case have some conscious purpose. It does not necessarily, in our usage, imply a human audience. The purpose may be for the control of a machine.

We view stalagmites as non-purposeful and stonehenge as purposeful, though they may be equally informative. More difficult is the distinction between the patterned, obviously sentient ululations of whale songs and such camp songs as: "alamen, alamen, alamen-si-kon-di-ipskiddy-boom-boom, yeah!"

We view dreams and DNA as non-purposeful because they are not the products of a conscious mind, yet we recognize them as information.

"Construction" implies that the symbols are used in a recognizable syntax, not language only. In fact the syntax may be so highly structured that the


INFORMATION
TANGIBLE
Whale Songs
Solar Flares
Stalactites
DNA
PURPOSEFUL
Camp Songs
Signal Flares
Stonehenge
Aspirin
Press Conference
Press Release
Recipes
COMMERCIAL
Lectures
Article
Cook Book
Rock Concert
Wind Sounds
Speeches
Performance
Newspaper
Text Books
Election Results
Dreams
Advice
Investment Research
Formula
Ballot
Investment Counseling
Financial Plan
Lab Notes
Stock Tip
Personal Records
Diary
PRIVATE

absence of symbols would have meaning as, for example, when the search of a database indicates that a given trademark has not been registered. Or, in a more famous example, when Sherlock Holmes noted that the dog didn't bark. The dog's habits were regular enough to constitute a predictable "syntax", such that its subsequent silence was highly informative.

John Cage occasionally performs his composition "4:44" which consists of a string quartet doing nothing for four minutes and forty-four seconds (often before a confused and restless audience). Morris Bishop, in one anthology, included as one of his poems as blank page, and great musical power is sometimes achieved with a caesura—a moment of silence just where one would have expected the rhythm to resume.

Although **"symbols"** can be very different we will take the liberty of grouping them in three conventional classes:

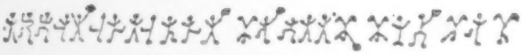
o Literary: the symbols are words and normal mathematical notation.

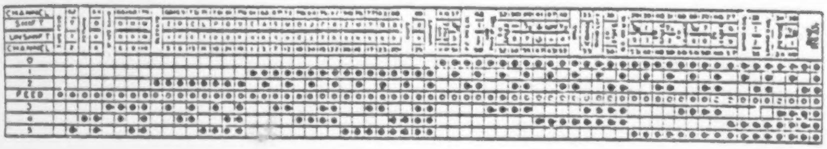
o Graphic: the symbols are colors, figures, shapes as well as special symbol sets such as cartography, meteorology and architecture.

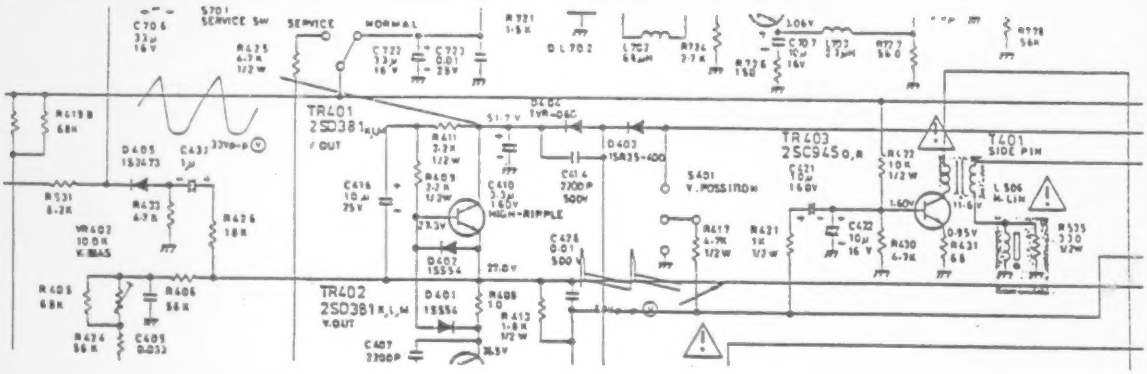
o Audio-Visual: the symbols include sound and motion as well as words other graphic symbols.

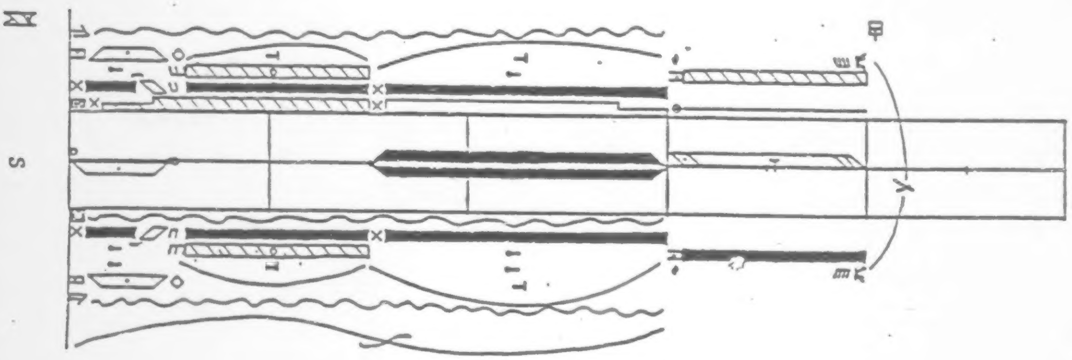
All but the simplest symbols must be learned, consequently symbols are more meaningful to some than to others. In our definition, we do not require that they be comprehensible, only that they be systematic.

Consider the following examples of well known symbol sets which nonetheless may have little meaning to the average person:[31]




CHANNEL
SHIFT
UNSHIFT
CHANNEL
FEED


C706
S701
SERVICE SW
SERVICE
NORMAL
R721
DL702
L702
R776
C707
R777
R778
R419B 68K
TR401
2SD381
V.OUT
D404
D403
TR403
2SC945
T401
SIDE PIN
D405
C431
R531
R433
R426
VR402
V.BIAS
C416
R411
R409
C410
HIGH-RIPPLE
C414
S401
V.POSSITION
C421
R422
L506
H.LIN
R535
D402
C425
R417
R421
C422
R430
R431
R405
R406
TR402
2SD381
V.OUT
D401
R408
R412
R424
C405
C407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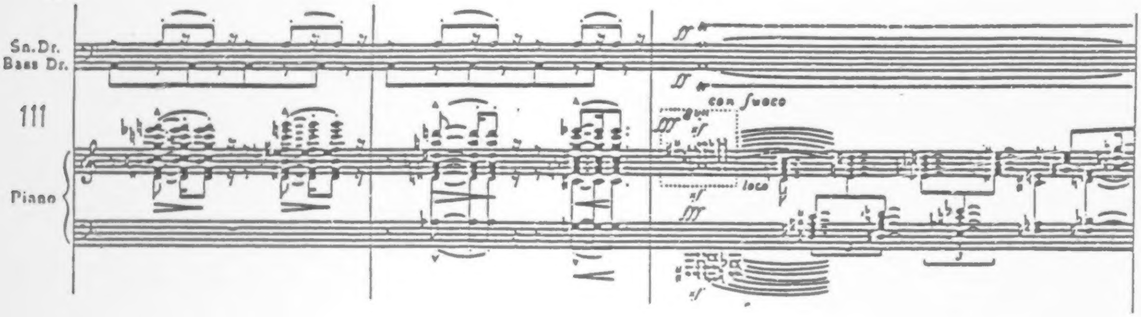

Sn.Dr.
Bass Dr.
111
Piano
con fuoco
loco

To accommodate these, we have created a fourth class:

- Non-literate notation: symbols whose meanings are not obvious to the average person. Included here are accessible symbol sets such musical notation, choreographic notation, cryptograms and computer programs as well as symbol sets that may not even be easily seen such as printed circuit diagrams (a syntax of and-gates, or-gates and junctions).

In focusing on the economics of information, it is useful to superimpose three additional discriminating criteria:

- Information may be fixed in a tangible medium or be ephemeral.
- Information may be public or private.
- Information may be commercial or not.

2. Fixed in a Tangible Medium

Does information exist independently of the author or the listener? If both leave the scene, does the information continue to exist for a third person?

The problem raised along the boundary between fixed and ephemeral information is that some constructions are designed to exist in both domains. A simple example is the song which is commercially exchanged in fixed form—musical notation—but only takes on full meaning when it is played.

In the case of electronic constructions the problems are more difficult. Some information is transformed for storage and distribution into a symbol set that is not meaningful to humans—a piano roll, perturbations along a record groove, the polarization of iron oxide molecules on magnetic tape—prompting some to argue that it has become machinery. In a sense it jumps from a tangible, but accessible form (video dislay) to another tangible but inaccessible form (magnetic disk storage). In our view the construction remains "information" even though it may have been temporarily transformed into an object that seems to have less meaning. After all, nothing is so uninformative as a closed book.

3. Publication and Privacy

Similarly, the distinction between whether information is private or public has been critical in determining the rules for its valuation and exchange. The test we propose for public-ness is simply whether any unrelated person can gain access to the information through legal means.

The public/private boundary, though, is a semi-permeable one through which private information almost inevitably oozes to the public. We will argue later that a critical element in information economics is the degree to which this oozing can be controlled.

One level of privacy is achieved simply by denying access through a variety of mechanisms ranging from a locked drawer to multi-level password schemes, and normally this privacy is easily recognized and defended. But another level of privacy exists which is more common and more troublesome. Shared privacy occurs when information is sold or given to others in a group with the promise that it will be held confidential.

It often happens with information that while the whole construction is kept confidential, enough critical pieces are separately released under different (and often legal) circumstances to permit someone to lawfully reassemble the construction in public. This was most recently demonstrated when *The Progressive* Magazine published directions for assembling a hydrogen bomb based on scraps of information which had become declassified over many years.

CAN INFORMATION BE COMMERCIAL IF IT IS NOT PRIVATE?

4. Commercial and Non-commercial Distribution

A final distinction is essential between information that is commercially and information which is not. By the former we mean information which is explicitly exchanged for other goods or services. When CBS paid John Erlichman for an on air-interview it was commercial. In the old days when they just took him out to dinner is was, by our definition non-commercial. Although a television signal is broadcast to all receivers without charge, we view television programming as a commercial service designed to distribute advertising to an audience which it has assembled.

Sometimes information offered free is then reorganized and offered commercially by someone else. Press releases, specifications and guidelines handed out at no charge by companies and government agencies are gathered and sold by such information companies as PR Newswire and IHS, provoking librarians and citizens alike to ask why it seems that they have to pay for the information "twice."

Even private information can become commercial such as credit ratings, security clearances and background checks. The $13 Billion direct mail business rests entirely on the premise that information about an individual's purchasing habits can be given out by the company with whom he did business. This is subsequently combined with other purchase information and demographic data about that neighborhood and sold many times to other direct mail marketers, magazine publishers and local service companies for prices as high as $1 a name.

Our interest is drawn inevitably to those information constructions which are embodied in a tangible form and exchanged commercially—modern information products and services which are the basic currency of the information age. Most information seems sooner or later to be captured in this way; the memorable speech, the most important teachings, public debates and even private revelations get recorded in one medium or another and become part of the civilization's memory, as well as its commerce. Problems of property protection surface here first and the relative economics of information can be seen here on a simple financial basis.

NOTES: Chapter 1

[1] Arnold Hauser, *The Social History of Art*, p. 65-65, quoted in Ploman and Hamilton, *Copyright*, p. 5.

[2] Victor Hazan, "The Origins of Copyright Law in Ancient Jewish Law", *Bulletin of the Copyright Society of the USA*, 18:1.

[3] Reid G. Adler, "Biotechnology as an Intellectual Property," *Science*, 224: April 27, 1884.

[4] Ploman, *op. cit.* p. 8

[5] According to Ploman, *op. cit.*, p. 141, China has a tradition of rewarding scientists and artists through patronage and recognition alone, and is the only country which still does not have a copyright law. There remains a strong belief that such laws would restrict the flow of vital information, illustrated most recently when a French artist of Chinese birth created a mosaic for a new Peking Hotel and was told to his surprise that his payment would be the "admiration of millions."

[6] *Ibid*, p. 6.

[7] Everett Mendelsohn, Professor of the History of Science, Harvard University, private conversation, October, 1984.

[8] Daniel Boorstin, *Discoverers*, p. 523.

[9] Daniel Boorstin, *op cit* pp. 512-515.

[10] Anthony Smith, *Goodbye Gutenberg*, pp. 99-10

[11] Daniel Boorstin, *op cit*, pp. 517-521.

[12] Daniel Bell, *Cultural Contradictions*, p. 16.

[13] Ploman, *op. cit.*, p. 7.

[14] *Ibid.*, p. 9.

[15] *Ibid.*, p. 11.

[16] *Ibid.*, p. 11.

[17] Daniel Bell, *Post-Industrial* pp. 174-177.

[18] Harlan Cleveland, "Information as a Resource"

[19] Bushkin and Yurow, *Foundations*, pp. 6-7.

[20] NCLIS, *Summary*, p. 42.

[21] Gregory Bateson, *Ecology*, TK

PUBLISHER'S NOTE:

The following pages are unavailable for filming:

I-20

[22] According to our conversations with Dr. Everett Mendelsohn, Professor of the History of Science at Harvard University, scientists from the 17th century on were rewarded with attribution through publication and eponymy—the practice of naming a phenomenon after the person who first observed it. But in the 19th century chemistry (for dyes) and bacteriology (for brewing) came suspiciously close to technology and some scientists distanced themselves from others by invoking the description "pure science". With a certain air of impoverished superiority, they shared their findings with others in their fraternity and tended to reject from their group those who were in it for the money. Today universities face a very prickly problem in determining the extent to which their faculty can use the university facilities to pursue science that may quickly become technology.

[23] Lewis Carrol,*Through the Looking Glass*, p. 115.Dumpty goes on, however, to explain, "when I make a word do a lot of work like that...I always pay it extra."

[24] Fritz Machlup, *Information*, pp. 641-671.

[25] Daniel Bell, *Post-Industrial*, p. 175.

[26] George A. Miller, *Psychology*, pp. 14-18.

[27] Paul Watzlawick, *How Real is Real?*, pp. 27-42.

[28] John Grier Miller, *Living Systems*, p. 13.

[29] Claude Shannon, "A Mathematical Theory of Communication," *Bell Systems and Technology Journal*, 1948, pp. 379-423.

[30] Norbert Weiner, *Cybernetics*, p. 76.

II. INFORMATION PRODUCTS AND SERVICES

A. Literary

Most of our information is still expressed, stored and exchanged in print. About 54% of the information economy as we have defined it here consists of the major print businesses: books, magazines, newspapers, newsletters, research and credit information, indexes, abstracts and other business data.

1. Books

The largest and oldest of these forms is the book which has existed in primitive ways since the early Chinese evolved the essentially graphic forms of woodblock images to the more systematic forms of Han Tzu, adding the syntax and organization necessary to embody long and complex ideas. The Arabic art of papermaking came to the West in the 8th century, freeing the medium from the relative scarcity of velum—the treated skin of animals. And with the invention of movable type by Gutenberg, printing presses emerged in 15th century Europe, creating a revolution that in many ways resembles the impact of computers on our own society. By the end of the century books were being printed in every major western country and in 1535 the first book publishing occurred in the New World at a press in Mexico City.[1]

With the development of mechanical typesetting equipment and rotary presses in the mid-nineteenth century, book publishing flourished in this country. Two thousand titles were published in the United States in 1880—about 164 titles for each million households. A century later 42,793 titles were published, or 530 per million households.[2]

Less than half of the estimated $12 billion spent in 1984 on books in the US comes from bookstores (Table II-1), and half of those books are purchased by 9% of the customers[3]; book buying is a highly concentrated activity. 25% of the book business is done with schools and libraries. 24% of the business is done through the mail, and in fact 6% of the adult population belongs to mail order book clubs.[4]

Viewed from a different perspective: 17% of the business is in hardback and paperback trade titles for adults, 5% is children's books, 13% is in mass market paperbacks and 15% is professional books. 27% of the book business is elementary, high school and college texts, keyed to enrollment and declining now in the wake of the baby boom.[5]

The book industry is best understood as having three major segments: (a) book manufacturing, about $3.3 billion in 1984, is done by commercial printers and binders who compete aggressively on the basis of their capital equipment, low labor costs and reputation for quality service.

(b) Book publishing, a $5.3 billion business not including manufacturing, consists of editors who identify, select and package manuscripts for a particular market, promotion specialists who call the title to the attention of that market and sales and fulfillment organizations who place the books in wholesale and retail inventory. Publishers succeed by understanding the needs of the market in which they specialize—children's, trade, textbooks, professional titles—and by skillfully attracting and enhancing appropriate manuscripts.

(c) Bookstores themselves are the third category with sales of $3.4 billion. They tend to specialize in a market segment (geographic, professional, subject, mass market) and provide full service at list price or various levels

TABLE II-1: BOOKS

	%	Revenue:	Equipment	Service	Advertsr	Industry
REVENUE		12012				
Bookstore Sales	0.46	5526				1.00
School & Library	0.25	3003		0.50		0.50
Direct Customer	0.24	2883		1.00		
Subsidiary Rights	0.05	601				1.00
Total	1.00	12012	0	4384	0	7628
% Distribution		1.00	0.00	0.37	0.00	0.64
EXPENSE		Expense:	Creation	Conversn	Distrbtn	Profit
Manufacturing	0.28	3363		0.33	0.67	
Royalties	0.10	1201	1.00			
Editorial	0.03	360	1.00			
Production	0.01	120		1.00		
Marketing	0.10	1201			1.00	
Fulfillment	0.08	961			1.00	
Direct Expenses	0.60	7207	1562	1230	4416	
Admin & Other	0.07	841	0.22	0.17	0.61	
Taxes	0.03	360				1.00
Profit	0.02	240				1.00
Total Expense	0.72	8649	1744	1374	4931	601
Bookstores	0.28	3363			1.00	
Total	1.00	12012	1744	1374	8294	601
% Distribution		1.00	0.15	0.11	0.69	0.05

Sources: 1984 estimated revenue ($million) is based on data from Dept of Commerce, Census of Manufactures, U.S. Industrial Outlook, Association of American Publishers.

Revenue is distributed according to its source: Equipment is paid by the customer to consumer electronics stores, Service is paid for information purchase or subscription, Advertiser is paid to the publisher or broadcaster by advertisers and Industry revenue comes from other information businesses and is treated a second time as an expense to those businesses.

Expense is distributed according to our judgment between creative, conversion and distribution activities. Creative is the cost of producing the first information construction, Conversion is the cost of embodying that construction in a form (typesetting, negative cost, database) appropriate for distribution; Distribution includes reproduction, shipping, advertising and promotion, as well as the discount allowed to retail outlets.

of lesser service (fewer titles, less assistance) at discount. Bookstores get a 40% to 50% discount on most titles, depending on the volume of the purchase, and have the privilege of returning unsold books for credit. College texts and some professional books, however, allow only 20% discounts on the theory that they are sold in large numbers for classroom use.

Book manufacturers require an investment of many millions to get started, and then they rarely fail. Publishers need little capital equipment, but have great difficulty getting established among authors, and bookstores which can start up overnight can fail with the same speed. In many ways the book business is a fashion business: it makes a small profit on a broad range of routine items, often loses money whenever it wanders from the beaten intellectual path but can make very high profits on those few titles each year which arrive at the peak of the market interest, which are wonderfully efficient or expressive or which deliver valuable new ideas.

2. Magazines

As many as 5,000 different magazines are published regularly in the United States,[6] providing a unique source of information to consumers, businesses, industries, professions and farms. A few are published weekly, but the majority are monthly journals which report on the technology, products and practices of similar households and organizations.

As an essential information exchange medium, magazines provide coherence and stability to a segment of the population that often has no other way to learn about its members. In cases like Datamation, New England Journal of Medicine, Modern Materials Handling and many others, magazines set the standards and the agenda for the industry they serve, while consumer magazines like

Sports Illustrated, Reader's Digest, Good Housekeeping and *Business Week* establish the level of knowledge and the values of their chosen constituency. They are a sometimes slow but usually responsible moderator and historian for their market.

45% of the $13 billion magazine revenue comes from the subscribers, while 55% comes from advertisers who are trying to reach that demographic or industry segment in the most efficient way (Table II-2). But this essential symbiosis is more than financial—readers want advertising that is interesting and relevant, and magazines like *The New Yorker* and *House Beautiful* have made this a key element to their success. Advertisers, in turn, want an audience that pays attention and an environment that lends credibility and even authority to their message.

While book publishers must find a new audience for each new title, magazines develop a subscriber list—a market conduit—which they maintain by providing consistently valuable information. The most successful magazines have developed a highly homogeneous audience that is otherwise difficult to reach, like *Bride*, *Byte*, *Yankee* or *Ski*.

Like book publishers, magazine publishers buy their manufacturing from specialized commercial printers who compete aggressively for this stable and lucrative $4.2 billion business. Distribution is done by the post office, which earns at least $500 million this way each year, and by newsstands which normally get 50% of the cover price for stocking the issue, along with the privilege of returning unsold copies.

The cost of editorial material is lower for magazines than for any other print medium because in many cases authors are willing to allow their material to be used without compensation in order to gain the professional exposure and

TABLE II-2: MAGAZINES

	%	Revenue:	Equipment	Service	Advertsr	Industry
REVENUE		13055				
Ad Revenue	0.55	7180			1.00	
Subscription Rev	0.30	3917		1.00		
Newsstand Revenue	0.15	1958				1.00
Total	1.00	13055	0	3917	7180	1958
% Distribution		1.00	0.00	0.30	0.55	0.15
EXPENSE		Expense:	Creation	Conversn	Distrbtn	Profit
Paper & Binding	0.32	4178		0.25	0.75	
Editorial	0.08	1044	1.00			
Ad Sales	0.08	1044	1.00			
Production	0.03	392		1.00		
Postage	0.04	522			1.00	
Circulation	0.30	3917			1.00	
Direct Expense	0.85	11097	2089	1436	7572	
Admin & Other	0.06	783	0.19	0.13	0.68	
Taxes	0.04	522				1.00
Profit	0.05	653				1.00
Total Expense	1.00	13055	2236	1537	8106	1175
% Distribution		1.00	0.17	0.12	0.62	0.09

Sources: Estimated 1984 revenue ($million) and expense distribution based on data from Dept of Commerce, U.S. Industrial Outlook, Folio Magazine, September, 1984.

status that comes with publication. In fact, in some scientific and technical journals the author is actually charged a "page fee" for publication, and this cost is usually included in the original research grant—often paid for by the government[7]

3. Newspapers

The largest information medium in the United States is newspapers. Over 1750 dailies share revenues of $26.7 billion and 7,500 weeklies share another $1.1 billion. Newsstands and newsboys earn another $2.6 billion on the sale and delivery of newspapers. (Table II-3). 62 million newspapers are distributed every day in the United States, of which 30% come from publishing companies belonging to one of 10 national chains.[8]

Circulation has declined slowly and steadily over the past four decades, due in large part to the consolidation of the industry. Competing newspapers have combined, failed or sold out so that now only a few dozen cities support more than one newspaper. At the same time regional papers have expanded their circulation into outlying cities and three newspapers have achieved national circulation: The Wall Street Journal, The New York Times and USA Today.

More seriously, newspaper readership has showed a steady decline. In 1961 80% of those polled had "read a newspaper yesterday" while in 1977 only 69% had. Losses have been greatest among high school graduates (down 23%) and skilled workers (down 24%).[9] While many explanations are offered for this decline[10] the primary cause is probably a shift to television. Households using television from 5pm to 8pm rose from 42% in 1965 to 52% in 1975, and hours of use per day rose from 5:29 in 1965 to 7:02 in 1980.[11] In 1967 a Roper poll showed that 24% found newspapers "the most believable news medium" compared to

TABLE II-3: NEWSPAPERS

	%	Revenue:	Equipment	Service	Advertsr	Industry
REVENUE		29350				
Ad Revenue	0.73	21426			1.00	
Subscription Rev	0.18	5283		1.00		
Newsstand Revenue	0.04	1174		1.00		
Newsboy Revenue	0.05	1468		1.00		
Total Revenue	1.00	29350	0	7925	21426	0
% Distribution		1.00	0.00	0.27	0.73	0.00
EXPENSE		Expense:	Creation	Conversn	Distrbtn	Profit
Newsprint & Ink	0.27	7925			1.00	
Editorial	0.08	2348	1.00			
Advertising	0.05	1468	1.00			
Production	0.13	3816		1.00		
Circulation	0.08	2348			1.00	
Direct Expense	0.61	17904	3816	3816	10273	
Admin & Other	0.14	4109	0.21	0.21	0.57	
Taxes	0.07	2055				1.00
Profit	0.09	2642				1.00
Total Expense	0.91	26709	4691	4691	12630	4696
Newsstand Cost	0.04	1174			1.00	
Newsboy Cost	0.05	1468			1.00	
Total	1.00	29350	4691	4691	15272	4696
% Distribution		1.00	0.16	0.16	0.52	0.16

Sources: Estimated 1984 revenue ($million) based on data from Dept of Commerce, US Industrial Outlook. Newsstand and Newsboy revenue based on data from six representative newspapers; expense distribution from Editor and Publisher.

41% who preferred television. In 1976, 22% found newspapers most believable compared to 51% for television.[12]

Some of this can be traced to changes in newspaper content. As broadsides in the seventeenth century, newspapers offered the opinions of the editor and "letters" from correspondents in far corners of the country. In the nineteenth century this was leavened by reprinting under the heading of "dispatches" articles from other newspapers which had arrived by post.[13] This practice of sharing became institutionalized as the Associated Press, a cooperative wire service owned by the newspapers which undertakes original reporting from major cities and foreign capitals and which also picks up stories from local newspapers that may have national interest.

With the consolidation of newspaper circulation, content became broader, more catholic and less opinionated. Political views were more successfully confined to personal columns and editorials and while there seemed to be little tempering of the journalist's behavior, newspapers became more alike. What they gained in coverage they lost in individuality and today all but a few dozen of the largest newspapers depend entirely on the wire service for state, regional, national and world news, restricting their original reporting to local news and features.

73% of the newspaper's revenue comes from advertising: half of that from local stores, movie theaters, banks, utilities and service companies. About a third of the advertising revenue comes from classified ads placed by real estate agents, automobile dealers and employment agencies. The balance comes from national advertisers and from preprinted advertisements inserted into the newspaper. Advertising is sold by the fraction of the page, and page rates are usually interpreted in cost-per-thousand-subscribers so although the newspaper does not set its prices directly in relation to circulation the effect is the same. For a newspaper with steady or slowly growing circulation, real revenue growth is very difficult.

U.S. newspapers consume about 20,000 metric tons of newsprint every day, at an annual cost of $8.4 billion.[14] For most daily newspapers, 25 cents barely pays for the paper it is printed on. These costs, along with the simple waste disposal problem which newspapers present, have prompted many to think that electronic distribution of the news would be cheaper and more attractive. In fact, however, the portability of newspapers coupled with their low cost capacity and "browsability" make them much more attractive than any electronic counterpart we can envision over the next decade.[15]

The newspaper is a mature medium faced with declining circulation and reduced opportunities for price or service increases. While further cost reductions are possible through automation, the economics of the industry are now tied to the advertising economy. Over the long term newspapers are likely to lose their role as the primary source of daily news in this country and become a supplemental medium offering local detail, perspective and opinion.

4. Information Services

Much is made of the information business these days because its market research, econometric models, directories, indexes, credit data and technical files seem to be what everyone means when they talk of the information age. But much of the business has been around for 100 years—Abraham Lincoln was a credit reporter for Dun and Bradstreet. In many ways the information services business is critical to our discussion: (a) it relies heavily on the derivative use of materials and so is often the trespasser as well as the victim of intellectual property transgressions. (b) Because it makes greater use of computers for processing and delivering information, this segment of the industry leads the others in discovering new uses and misuses of the technology. (c) Because the clients are businesses and the information is frequently of high value, information companies are more sensitive than most to questions of exclusivity and pricing.

The information services business is itself split between the old, print-oriented ways and the new online systems, and while they are often combined as the products of a single company it is easier to understand them separately. The print oriented business (Table II-4) amounts to $11 billion in 1984 and consists primarily of subscription services. Market research is the largest area of activity constituting about 28% of the industry and including syndicated measurement of television and magazine audiences, product sales, share-of-market and installed equipment data as well other information critical to the development of appropriate pricing and product strategy decisions.[16]

Econometric and financial services are the second largest component with about 15% of the industry's revenues. Economic forecasts, statistical and investment data on securities, financial and actuarial services are all delivered in the form of looseleaf services, directories, bulletins, statistical compilations and reports.

Credit and check authorization data ~~is~~ are 11.5% of the industry or about $1.3 billion a year; product information, specifications and directories are 8.4% and looseleaf services and legal research tools amount to 7.6%. Other subject areas include medical, scientific and technical abstracts, as well as indexes and research tools related to public data and government reports.

TABLE II-4: INFORMATION SERVICE - PRINT

	%	Revenue:	Equipment	Service	Advertsr	Industry
REVENUE		10985				
Subscription Rev	0.96	10546		1.00		
Interest	0.04	439		1.00		
Total Revenue	1.00	10985	0	10985	0	0
% Distribution		1.00	0.00	1.00	0.00	0.00
EXPENSE		Expense:	Creation	Conversn	Distrbtn	Profit
Editorial	0.24	2636	1.00			
Production	0.16	1758		0.50	0.50	
Sales & Marketing	0.19	2087			1.00	
Distribution	0.10	1099			1.00	
Direct Expense	0.69	7580	2636	879	4064	0
Admin & Other	0.16	1758	0.35	0.12	0.54	
Taxes	0.07	769				1
Profit	0.08	879				1
Total Expense	1.00	10985	3248	1083	5007	1648
% Distribution		1.00	0.30	0.10	0.46	0.15

Sources: Estimated 1984 revenue ($million) and expenses based on data from Business of Information, 1983, Information Industry Association.

The industry is relatively young—more than half of the companies were formed since 1970.[17] The businesses are small—half of them had revenues of less than $1 million in 1982. And even the print sector of the business is growing at an expected 11% per year.

The strategies of information companies normally include three tenets: (a) become the authority—on whatever subject you have chosen, become the most consistently reliable and useful source. (b) Capture the market: once you have established a conduit to your chosen market, meet all its information needs in whatever medium the market finds most useful. (c) Be technically innovative: computer and communications technologies offer new tools for the organization, storage and delivery of information. The leader must find them first.

In practice, information service companies spend nearly twice as much on content as any other print medium. They conduct research, build complex data compilations, methodically track product sales, report the price of securities and document the characteristics of products in every category. This information is delivered in the form of monthly looseleaf updates, research reports or revised directories, in print or in microform, on a subscription or straight priced publication basis.

Often, but not always, the information is considered confidential to subscribers; photocopying is discouraged and sharing the data with others is specifically prohibited by the subscription contract. And the documents are expensive: an annual subscription to a monthly professional information service may cost $800, and a market research report shared by others in the industry may cost $15,000 per copy.

Trade books are priced in the context of a general sense of "fair value"—usually in relationship to the production cost. Magazines and newspaper pub-

WHAT DOES "IN RELATIONSHIP TO" MEAN?

lishers set "newsstand" prices largely dictated by the competition, then "buy" subscriptions through various direct mail offers in order to maintain the circulation they have guaranteed their advertisers. But in the case of information services the pricing context is less clear, and the purchaser must decide whether the *information* is worth that much *to him.* In many cases it clearly is: information service subscribers normally renew at the rate of 70% or higher, compared to magazine subscribers ~~which~~ who renew at rates of 25% to 30%.

Online information services present a different set of issues: In 1966 Lockheed Information Systems (now DIALOG) began to offer access to a computer index of scientific materials including *Index Medicus*, a comprehensive index to medical literature which had been published by the National Library of Medicine for over 100 years. Other files were added, primarily in the scientific and medical areas. The New York Times launched an online database of abstracts in 1975, providing access to dozens of major publications as well as its own. In 1980, the Directory of Online Databases included 600 different files and in 1984 there are nearly 2500.[18] Based on the IIA survey of 1982, we estimate that these services now account for revenue of $3.6 billion. (Table II-5).

According to a 1982 analysis by Frost and Sullivan,[19] 40% of these databases were bibliographic and included only the title, author, publisher and date of each document and an abstract or subject categories for which it might be relevant. 41% were numeric databases consisting of economic, product, financial or research data. 13% included both text and data, such as records of aviation accidents, and 6% were text only such as legal cases or the text of research documents.

Publishers, economists and researchers produce about two thirds of these databases, government agencies produce 15% and universities and professional

TABLE II-5: INFORMATION SERVICE - ONLINE

	%	Revenue:	Equipment	Service	Advertsr	Industry
REVENUE		3650				
Service Revenue	0.85	3103		0.90		0.10
Terminal Equipmnt	0.15	548	1.00			
Total	1.00	3650	548	2792	0	310
% Distribution		1.00	0.15	0.77	0.00	0.09
EXPENSE		Expense:	Creation	Conversn	Distrbtn	Profit
Operations	0.25	913	0.50	0.50		
Systems & Comm	0.23	840		0.50	0.50	
Sales & Marketing	0.17	621			1.00	
Direct Expense	0.65	2373	456	876	1040	0.00
Admin & Other	0.11	402	0.19	0.37	0.44	
Taxes	0.04	146				1.00
Profit	0.05	183				1.00
Total Expense	0.85	3103	533	1024	1216	329
% Distribution		1.00	0.17	0.33	0.39	0.11
Equipment Sales	0.15	548			1.00	
Total Expense	1.00	3650	533	1024	1764	329
% Distribution		1.00	0.15	0.28	0.48	0.09

Sources: Estimated 1984 revenue ($million) and expenses based on data from Business of Information, 1983, Information Industry Association, and from Online Database Systems, Frost and Sullivan, 1983.

associations produce about 18%. In most cases the producer compiles the data in machine readable form and then delivers ~~it~~ them to an intermediary who operates the computer system on which the data ~~is~~ are stored—Dialog is the largest of these services, BRS, SDC, Dialcom, Compuserve and ICI are others. The services in turn sell their combined databases to subscribing libraries and research organizations, they provide training and assistance and bill the subscriber on behalf of all the database producers. Although the function is similar to a newsstand which tries to carry a wide range of magazines, database services pay the database producer a royalty that may be low as 5% or as high as 30% of revenues.

The profitability of database publishing has been quite varied—we estimate that at least half the database publishers in the United States lost money on their databases in 1984 while a few large, well established companies like Mead Data Central, Data Resources and Dow Jones may have pre-tax profits ✓ as high as 12%. of WHAT ? Online publishing is still young; the publishers must sell the need as well as the solution and the real profitability test will not occur for several years when the population of users grows from about 300,000 researchers to over 1 million direct users.

5. Document Retrieval

In spite of the massive industry dedicated to delivering information—or perhaps because of it—a new segment of the information industry has emerged with estimated revenues of $660 million (Table II-6). It consists of small research companies and a few major libraries that have made a business out of finding documents and copying them for users. In the private sector these are called "fee-based libraries", "on-demand companies" or sometimes "information brokers". They also include 5,000 special research libraries in the United

TABLE II-6: DOCUMENT RETRIEVAL

	%	Revenue:	Equipment	Service	Advertsr	Industry
REVENUE		660				
On Demand Co's	0.24	158		1.00		
Library Copying	0.76	502		1.00		
Total	1.00	660	0	660	0	0
% Distribution		1.00	0.00	1.00	0.00	0.00
EXPENSE		Expense:	Creation	Conversn	Distrbtn	Profit
Royalties	0.03	20	1.00			
Operations	0.32	211	0.20	0.20	0.60	
Systems & Comm	0.11	73		0.50	0.50	
Sales & Marketing	0.18	119			1.00	
Distribution	0.14	92			1.00	
Direct Expenses	0.78	515	62	79	374	
Admin & Other	0.18	119	0.12	0.15	0.73	
Taxes	0.02	13				1.00
Profit	0.02	13				1.00
Total Expense	1.00	660	76	97	461	26
% Distribution		1.00	0.12	0.15	0.70	0.04

Sources: Estimated 1984 revenue ($million) and expenses based on data from *Business of Information, 1983*, Information Industry Association, and from Maranjian, *Fee-Based information Services*, 1984. Library Copying data from NCLIS, *Library Photocopying in the United States*, 1978.

States supported by a few inter-library loan networks such as the Ohio College Library Conference (OCLC) and the British Lending Library.

According to the Survey of Library Photocopying,[20] 63 million books and journal articles were copied in libraries during 1976, plus another 38 million articles and books which were borrowed from other libraries for the purpose of copying. We assume that this volume has increased since then. 42% of all copying was done by academic and corporate libraries.

In addition, we estimate that a few private companies—University Microfilms, Find/SVP, Information on Demand—and several dozen federally funded clearinghouses make another 5 million copies each year.[21] Based on the 1982 IIA survey we estimate revenue for this activity at $158 million in 1984.

Information On-Demand is a good example of how a major document retrieval company does business. With revenues of about $1 million, the small San Francisco company maintains a network of "runners" associated with a dozen major libraries in the United States, along with reciprocal relationships with the British Lending Library and the Lenin State Library in Russia. Requests for documents are sent out to the runner where the document is most likely to be found, the runner looks up the article or book, makes a copy on the library photocopier, replaces the article and sends the copy back to San Francisco where it is forwarded to the requestor. Turnaround is normally 3 to 10 days and the fee is $7.50 plus 15 cents per page. The company retrieves an estimated 100,000 articles a year this way, 80% of which are scientific and medical. 60% of the documents are less that two years old.[22]

We have not attempted to determine how much, if any, of this copying is unauthorized: our own experience is that most commercial on-demand companies are careful to gain all necessary rights and permissions for any copying they feel is not "fair use". The Copyright Clearance Center, established in 1977 to collect such permission fees, reports that they collected $1 million in 1984, and that the average fee is $2.

5 million copies x $2 should equal $10 million !

6. Radio Broadcasting

For about 25 years after Marconi's 1895 demonstration of the apparatus for transmitting electrical impulses through the airwaves, the commercial development of radio was inhibited by patent battles and a lack of receiver standardization. But in the United States a cross-licensing agreement between General Electric, RCA, AT&T and Westinghouse established a common standard and receiver sales boomed.

By 1922, advertising time was being sold to underwrite radio programming costs and a year later the first radio network was born linking together three AT&T stations. The reason for networking was compelling—an increased audience lowered the per-listener production cost and increased the value of advertising time. Until a 1926 negotiated agreement, however, other radio companies were unable to network their stations for lack of access to long distance lines (AT&T used its own). In 1926 AT&T sold its stations to RCA and the new group became the NBC radio network.[23]

Because of its early entry, NBC gained the most desireable frequencies and the most favorable locations. It dominated radio in the 1930's offering two networks ~~channels~~—red and blue—providing commercial and sustaining ~~public service~~ programming respectively. Cigar business heir William Paley, searching for a better advertising medium, formed what became the CBS radio network in 1928. Although CBS became immediately profitable, its radio operations never caught up with NBC.

MUTUAL ?

In 1945 95% of all radio stations were network affiliates but by 1955 only 50% remained so. Network revenue declined steadily as television won over the national advertisers and today only a small percentage of the stations retain their network affiliation. Audiences no longer desire the drama and variety shows that had been the network's primary programming contribution and most stations have turned to playing records which are provided free by the record distributors.

MANY NETWORKS
BUT PROVIDE
SPECIAL SERVICES,
NOT FULL
PROGRAM
LINEUP.

Today there are about 9300 commercial AM and FM stations in the U.S., and while radio is not the dominant medium it was in the days before television, it still enjoys wide listenership and revenues of $5 billion (Table II-7)

7. Television

Although television programming was offered before and during World War II, the broadcast TV industry is really part of the post-war baby boom with receiver population growing from 172,000 in 1947 to 940,000 in 1948. The infant television industry enjoyed a sort of natural delivery from radio. Not only did the three radio networks quickly establish themselves in television but radio stations became television stations and radio advertisers became television advertisers.

THERE WERE
FOUR RADIO
NETWORKS.

The idea of networks was as attractive for television as for radio and after 1952 when the FCC limited the number of stations that could operate in any city it was virtually assured that only three networks could be viable.

In the early years the networks supplied about half of the programming aired on the stations. Advertising agencies were the major program producers—as they had been in radio—but soon the networks were ^ their own material and selling "commercials" to several sponsors in each show.

✓

TABLE II-7: RADIO

	%	Revenue:	Equipment	Service	Advertsr	Industry
REVENUE		7013				
Ad Revenue	0.72	5049			1.00	
Radio Receivers	0.28	1964	1.00			
Total	1.00	7013	1964	0	5049	0
% Distribution		1.00	0.28	0.00	0.72	0.00
EXPENSE		Expense:	Creation	Conversn	Distrbtn	Profit
Music Fees	0.01	70	1.00			
Programming	0.21	1473	0.50	0.50		
Sales & Marketing	0.20	1403			1.00	
Technical	0.04	281		0.50	0.50	
Direct Expense	0.46	3226	806	877	1543	0
Admin & Other	0.22	1543	0.25	0.27	0.48	
Taxes	0.02	140				1.00
Profit	0.02	140				1.00
Total Expense	0.72	5049	1192	1296	2281	281
% Distribution		1.00	0.24	0.26	0.45	0.06
Radio Receivers	0.28	1964			1.00	
Total	1.00	7013	1192	1296	4244	281
% Distribution		1.00	0.17	0.18	0.61	0.04

Sources: Estimated 1984 revenue ($million) and expenses based on FCC Annual Report, Dept of Commerce, US Industrial Outlook. Radio receiver sales from EIA, *Electronic Market Data Handbook, 1983*.

series

Today networks concentrate on news, sports and made-for-TV movies, buying virtually all of their programming on a license fee basis from independent producers. ~~who have offered them "pilots"~~. "Magnum P.I.", for example, was purchased by CBS for $1.6 million per episode. While the fee is meant to cover the cost of the programs, the producers routinely invest more in production and hope to recover ~~overhead~~ the remainder and earn profits from future syndication and foreign sales. But only one in ten shows lasts long enough on the network to be eligible for this subsidiary sale under normal circumstances.

SOURCE ?

Those programs that make it into syndication very often command higher fees from the local stations than they received from the networks. "Star Trek", which only produced 79 episodes, is now syndicated at 50 times the price of its original network license fee. Overall, production companies receive about 77% of their revenue from license fees, 17% from U.S. syndication sales, 4% from foreign sales and 2% from video cassette sales and other sources.

SOURCE ?
INFLATION ADJUSTED ?

Networks recover their enormous investment by selling seven minutes of commercials in each of the three and one half hours of prime time which ~~it~~ they supplies to ~~its~~ their affiliated stations. A minute during the Super Bowl, for example, cost the advertiser $1 million. In spite of these prices and the erosion of the audience caused by cable and VCR use, demand for network commercial time is at an all time high.

WHAT ABOUT DAYTIME PROGRAMMING? LATE FRINGE? MORNING?

INDEPENDENT STATIONS ?
FIRST
RUN
NDICATION?.

The 813 commercial television stations in the United States receive about 45% of their revenue from local advertisers (Table II-8), 46% from national advertisers ~~buying time on local programs~~ (called "national spot sales") and 9% from the networks with which they are affiliated.[1] The network, in turn, sells advertising time in the programming it supplies to the stations. Whether the

TABLE II-8: TELEVISION

	%	Revenue:	Equipment	Service	Advertsr	Industry
REVENUE		22172				
Advertising Rev	0.62	13747			1.00	
TV Receivers	0.26	5765	1.00			
VCR (66 % sales)	0.12	2661	1.00			
Total Revenue	1.00	22172	8425	0	13747	0
% Distribution		1.00	0.38	0.00	0.62	0.00
EXPENSE		Expense:	Creation	Conversn	Distrbtn	Profit
Films & Licenses	0.05	1109	0.50	0.50		
Programming	0.08	1774	0.50	0.50		
Sales & Marketing	0.06	1330			1.00	
Technical Costs	0.05	1109		0.50	0.50	
Direct Expense	0.24	5321	1441	1995	1885	0
Admin & Other	0.16	3548	0.27	0.38	0.35	
Taxes	0.10	2217				1.00
Profit	0.12	2661				1.00
Total Expense	0.62	13747	2402	3326	3141	4878
% Distribution		1.00	0.17	0.24	0.23	0.35
TV Receivers	0.26	5765			1.00	
VCR Equipment	0.12	2661			1.00	
Total	1.00	22172	2402	3326	11566	4878
% Distribution		1.00	0.11	0.15	0.52	0.22

Sources: Estimated 1984 revenue ($million) and expenses based on FCC Annual Report, National Association of Broadcasters, *Television Financial Report*. TV receiver sales from EIA, *Electronic Market Data Handbook, 1983*. VCR sales from *Time*, December 24, 1984. 64% of VCR sales attributed to TV based on Nielsen survey (Time) showing users said time-shifting was most important use.

network is "buying" the local audience or "selling" its programming depends on one's point of view, but it is a relationship that has led to a rising share of national advertising dollars for television, a rising level of homes using television and pre-tax profits for television stations that average 22% of what ? and can soar to 60% in some markets.

The long term outlook for television, however, includes several disturbing issues: (a) cable television brings competing programming into the market, with the result that all stations have to compete harder for a smaller share of the audience. (b) Alternative uses for television, such as videotapes, video discs and home video recording all further erode the audience for conventional programming, and (c) with more programming outlets bidding for original and syndicated materials, the cost of maintaining a competitive service increases. As television audiences become more fragmented, advertising supported stations may be forced to reduce their rates, and that in turn will increase the competitive pressure on newspapers and magazines.

8. Cable Television

Cable television is really two industries, the most visible of which is the program production sector which develops and supplies movies, children's programming, sports events and special interest material. Many cable systems are operated by several large groups—multiple systems operators (MSO's)—who serve 40% of the nation's 37 million cable subscribers (Table II-9). The rest of the cable systems are run by small independent companies which grew out of television sales and repair shops. The operators bid for the municipal license to build a cable network in the city, they maintain the network and the central transmitting facility (called the "head end") and they buy pay television programming from national suppliers and sell it to their subscribers.

WHICH TWO ?

TABLE II-9: CABLE

	%	Revenue:	Equipment	Service	Advertsr	Industry
REVENUE		5954				
Basic Service	0.63	3751		1.00		
Pay Service	0.28	1667		1.00		
Ad Revenue	0.09	536			1.00	
Total	1.00	5954	0	5418	536	0
% Distribution		1.00	0.00	0.91	0.09	0.00
EXPENSE		Expense:	Creation	Conversn	Distrbtn	Profit
Program Fees	0.05	298	1.00			
Operations	0.32	1905	0.20	0.20	0.60	
Systems & Comm	0.11	655		0.50	0.50	
Sales & Marketing	0.18	1072			1.00	
Distribution	0.12	714			1.00	
Direct Expenses	0.78	4644	679	709	3257	
Admin & Other	0.18	1072	0.15	0.15	0.70	
Taxes	0.02	119				1.00
Profit	0.02	119				1.00
Total Expense	1.00	5954	835	872	4008	238
% Distribution		1.00	0.14	0.15	0.67	0.04

Sources: Estimated 1984 revenue ($million) and expenses based on FCC, Cable TV Industry Revenues, and on growth estimated by Paul Kagan Associates.

The subscriber pays $8 to $10 a month to receive basic cable including all the local television stations and whatever other programming has been required by the city in awarding the franchise. In addition, the subscriber may elect one or more of the "pay channels" that normally offer movies and special interest programming. Finally, the subscriber may choose to buy a single program—usually a sports event—by signing up in advance. RARELY OFFERED. MOST SYSTEMS CANNOT OFFER PAY-PER-VIEW

The system operator in turn pays his program suppliers, usually on a per subscriber basis, as well as paying a portion of his revenues to the city. He takes relatively fewer risks THAN WHO? and has been more reliably profitable over the years although the newer cable systems have enormous capital requirements and have in many cases promised the city to provide more services than they can afford to do.

In return for granting cable companies a "right of way" for construction—the right to bury cable along city roads or to hang it on utility poles—the city normally receives 3% or more of the system gross revenues along with various services in kind, such as ~~video production equipment for schools and community centers.~~ In many cases the city also holds the right to regulate the rates the system can charge its customers for basic service. In October, however, Congress enacted federal legislation which puts a limit on the percentage the city can require and, over a period of two years, releases the cable companies from municipal rate regulation. PAY RATES ALREADY DEREGULATED. BASIC RATES MAY BE DEREGULATED IF FCC FINDS THERE IS EFFECTIVE COMPETITION.

The programmers, like independent television producers, take very significant risks by buying and developing special interest channels for cable which they hope will be popular, but over the last few years they have generally been unprofitable.

MORE LIKE NETWORKS!

9. Motion Picture Industry

In 1889 Thomas Edison and his associates developed the kinetograph, a camera which exposed sequential pictures on rolls of celluloid film, and the kinetoscope which projected the developed rolls on a silver screen. By 1896, "movies" were a feature of many vaudeville shows and in 1905 the first movie house opened in Pittsburgh. Tickets were five cents.

By the 1930's the motion picture business was pervasive and influential—65% of the population went to the movies every week—but by 1960 television had done to movies what movies did to vaudeville and today weekly attendance has stabilized in the U.S. at about 8%.

During the "Golden Age" of the 30's and 40's a few major studios—MGM, Paramount, Universal, 20th Century Fox and Warner Brothers—controlled the industry, owning everything from writers and actors contracts to the neighborhood theaters. But hard times and new regulations have turned most of those original companies into "distributors" who buy movies from independent producers and sell them to independent theaters and theater chains.

MOST STUDIOS ARE MORE THAN DISTRIBUTORS!

Inevitably the segments of the industry overlap. Actors like Clint Eastwood form their own production companies. Production companies attempt their own distribution (usually without success), and distributors occasionally rent out the local theater "wall to wall" and go into the exhibition business. Whatever economies there may be in vertical integration, though, seem to have no validity in the movie business where the financial aspect of a picture can sometimes be as complicated as the plot.

The cost of creating a movie (often called the "negative cost")—from hiring a director to editing the final version of the film—averages $10 million, although "Dune" and "Cotton Club" cost over $40 million each. Normally this money is advanced to the producer by the distributor who may or may not, in turn, exact a measure of creative control.

When the film is accepted, the distributor makes copies of the negative ($12,000 per copy) and makes arrangements with local theaters throughout the country for play dates, division of box office receipts and commitment to advertising and promotion. The cost of this activity is usually about $15 million, of which half goes to advertising. Like book publishing, the costs are nearly all up front and the risks are very high (Table II-10).

Major distributors usually handle fewer than 20 films a year, and of these only five will be profitable at the box office. Other revenues from foreign distribution, television, cable and video cassettes will bring another one or two films into the black, and overall the distributor will hope to make a profit. CIT.

10. The Record Industry

Like movies, cable and broadcast television, the record business consists of production companies and distributors. In the 30's and 40's the major record companies signed talent, selected material, produced and distributed the final product but today, like the movie distributors, they provide the independent producer an advance against royalties and then, if they like the master, they commission the manufacturing and mount the promotional and distribution campaign. In some cases the artist and the production company control even the album cover and the ad campaign.

Although no one has yet found a way to do without the artist, the acknowledged creative force behind a successful record today is the producer who

TABLE II-10: MOTION PICTURES

	%	Revenue:	Equipment	Service	Advertsr	Industry
REVENUE		9647				
Exhibitor Revenue	0.25	2392		1.00		
Studio Revenue						
Exhibitors	0.18	1698		1.00		
Cassette Sales	0.07	685		1.00		
TV, Frgn & Lisnc	0.22	2113				1.00
VCR Equipment-34%	0.13	1254	1.00			
Tape Rental	0.16	1505		1.00		
TOTAL	1.00	9647	1254	6280	0	2113
% Distribution	1.00	9647	13.00	65.10	0.00	21.90
Studio Expense		Expense:	Creation	Conversn	Distrbtn	Profit
Negative Cost	0.17	1640	0.60	0.40		
Advertising	0.12	1158			1.00	
Distribution	0.04	386			1.00	
Direct Expense	0.33	3184	984	656	1544	0
Admin & Other	0.03	289	0.31	0.21	0.48	
Taxes	0.05	482				1.00
Profit	0.06	540				1.00
Total Expense	0.47	4496	1073	716	1684	1023
% Distribution		1.00	0.24	0.16	0.37	0.23
Exhibitor Expense	0.25	2392			1.00	
Equipment Expense	0.13	1254			1.00	
Rental Expense	0.16	1505			1.00	
Total Expense	1.00	9647	1073	716	6835	1023
% Distribution		1.00	0.11	0.07	0.71	0.11

Sources: Estimated 1984 revenue ($million) based on Census of Manufactures estimate of total industry revenue, Box Office revenue from US Industrial Outlook, Home Video and VCR revenue from Time, December 24, 1984. VCR is allocated 34% to movies based on Nielsen survey (Time) showing television time shifting was most important use. Box office revenues are estimated at $4 billion in 1984, of which we estimate that 60% was retained by the exhibitor and 40% paid to the studio. Studio revenues are estimated as $4619 million in 1984 (Time) of whch $625 million came from video cassette sales and the balance from other sources. We estimate that the 17 million VCR owners spend $50 a year on video tape rentals.

picks the theme, the songs, the backup music and then supervises the final mix from 48 tracks down to 2. For many, the genius behind "Thriller" is not Michael Jackson but Quincy Jones, the producer.

The cost of creating a single LP averages $120,000 and can run as high as $500,000, but there is no correlation between this cost and success—85% of the records cut in the United States never break even.

Contrary to popular opinion, only 43% of the records are sold to persons under 25, although most promotion efforts are aimed here because younger people are considered more easily influenced. 35% of record sales come from rock music--the most volatile and potentially the most profitable sector.

From 1980 to 1982 the record industry suffered a 25% drop in revenues and profits, though in the last few years the industry has recovered somewhat through reduction in promotion expenses and the introduction of a new 12" single with four to six songs and priced at half the traditional price of an album (Table II-11). Music videos have stimulated the market and record companies now offer these free to cable programmers who, as it turns out, are looking for low cost entertainment. In the long run, new digital recording techniques and optical disks promise to inject the industry with remarkable new audio fidelity. No other medium seems to present any fundamental competition for music, one of man's oldest entertainments.

TABLE II-11: RECORDS AND TAPES

	%	Revenue:	Equipment	Service	Advertsr	Industry
REVENUE		6100				
Records & Tapes	0.64	3904		0.10		0.90
Audio Components	0.36	2196	1.00			
Total	1.00	6100	2196	390	0	3514
% Distribution		1.00	0.36	0.06	0.00	0.58
EXPENSES		Expense:	Creation	Conversn	Distrbtn	Profit
Publisher's Fee	0.03	183	1.00			
Artists Royalty	0.14	854	0.50	0.50		
Recording Expense	0.04	244		1.00		
Manufacturing	0.10	610		0.50	0.50	
Sales & Marketing	0.06	366			1.00	
Direct Expense	0.37	2257	610	976	671	0
Admin & Other	0.14	854	0.27	0.43	0.30	
Taxes	0.03	183				1.00
Profit	0.03	183				1.00
Total Expense	0.57	3477	841	1345	925	366
% Distribution		1.00	0.24	0.39	0.27	0.11
Record Stores	0.29	1769			0.90	0.10
Equipment Dealers	0.14	854			0.90	0.10
Total	1.00	6100	841	1345	3286	628
% Distribution		1.00	0.14	0.22	0.54	0.10

Sources: Estimated 1984 revenue ($million) and expenses based on Dept of Commerce, US Industrial Outlook, Recording Industry Association of America. Standard and Poors Industry Surveys.

TABLE II-12: PERFORMING ARTS

	%	Revenue:	Equipmnt	Service	Advertsr	Industry
REVENUES		4070				
Theater	0.15	630		1.00		
Opera	0.33	1350		1.00		
Symphony	0.52	2090		1.00		
Total	1.00	4070	0	4070	0	0
% Distribution		1.00	0.00	1.00	0.00	0.00
EXPENSES		Expense:	Creation	Conversn	Distrbtn	Profit
Royalties	0.15	611	1.00			
Production Costs	0.32	1302	0.20	0.20	0.60	
Sales & Marketing	0.18	733			1.00	
Distribution	0.14	570			1.00	
Direct Expenses	0.79	3215	871	260	2084	
Admin & Other	0.17	692	0.27	0.08	0.65	
Taxes	0.02	81				1.00
Profit	0.02	81				1.00
Total Expense	1.00	4070	1058	317	2532	163
% Distribution		1.00	0.26	0.08	0.62	0.04

Sources: Estimated 1984 revenue ($million) and expenses based on Dept of Commerce Statistical Abstract, 1982-1983. Very little is available on the economics of this sectors.

NOTES: Chapter II

[1] Marshall Lee, Bookmaking, pp. 3-4.

[2] Dept of Commerce, Historical Statistics.

[3] Benjamin Compaine, Magazines, p. 41.

[4] Benjamin Compaine, op cit.

[5] Standard and Poor Industry Survey, August 1984, p. 87.

[6] Christopher Sterling, Electronic Media, p. 344.

[7] Donald King et al, Scientific Journals, pp. 72-74.

[8] Editor and Publisher, Yearbook 1984.

[9] Audits and Surveys Data, The Media Book, 1979.

[10] Leo Bogart, Press and the Public.

[11] Christopher Sterling, Electronic Media, p. 242.

[12] Christopher Sterling, Handbook, p. 274.

[13] Bruce Owen, Economics and Freedom of Expression, Ballinger, 1975 pp.37-48.

[14] ANPA, Facts about Newspapers, 1983.

[15] This is a controversial opinion. In 1978, Arthur D. Little, Inc. undertook a comprehensive evaluation of the impact of electronic publishing on the newspaper industry and concluded that the newspaper would survive. Since then several popular books have raised the specter of the "dying newspaper" but none has supported this prediction with any analysis, and the consensus among those who study electronic publishing remains that while electronic publishing is very real and significant, the impact on newspapers will be minimal over the next decade.

[16] IIA, Business of Information, 1983

[17] IIA, op. cit.

[18] Frost and Sullivan, Online Database Systems, 1983.

[19] Ibid.

[20] NCLIS, Library Photocopying, pp. 1-13.

[21] Lorig Maranjian, Fee-Based Information Services.

[22] *Ibid*

[23] David Halberstam, *The Powers That Be*, pp. 23-31

I KNOW MOST ABOUT RADIO, TV, AND CABLE AND FOUND THE DESCRIPTIONS OF THESE SOMEWHAT LACKING.

III. THE ORIGINS OF VALUE

Information in the right place at the right time has benefit and getting it there certainly has a cost--but when does the cost exceed the benefit? When a modern consumer encounters an information product or service, how does he assay its worth? What are the values of information and where do they come from?

A. The Relative Value Calculation

The popular notion attributes most value of information to its content, recognizing that a faithful report displaces the cost of attending the event and that an entertaining novel may offer temporary escape from one's daily life or a lens through which to see it more clearly. We think of the "author" as the source of this value, and the manufacturing and distribution process as a market necessity. And perhaps all this was once true. But the changing nature of the information business--the way we create, distribute and use information--requires us to look again.

It is hard to find the authors any more. A Columbia University study for the Author's Guild in 1979 found only 1003 "full time" authors in this country and barely a thousand more "part time" authors. The scarcity was understandable: the average author's income was $5,000 a year with 10% earning more than $45,000 and 5% earning more than $80,000.[1]

Our own analysis presented in Section II suggests that fewer that 17% of all the employees in the information industry could be described as authors, editors, designers, performers, or artists, and that of the $143.6 billion spent every year on information in the United States, only $22 billion goes to create content. This is certainly the critical element which gives all other activities their meaning, and yet the sheer size of those other activities—equal to all of U.S. agriculture, forestry and fisheries combined—suggests that the values they contribute must also be understood.

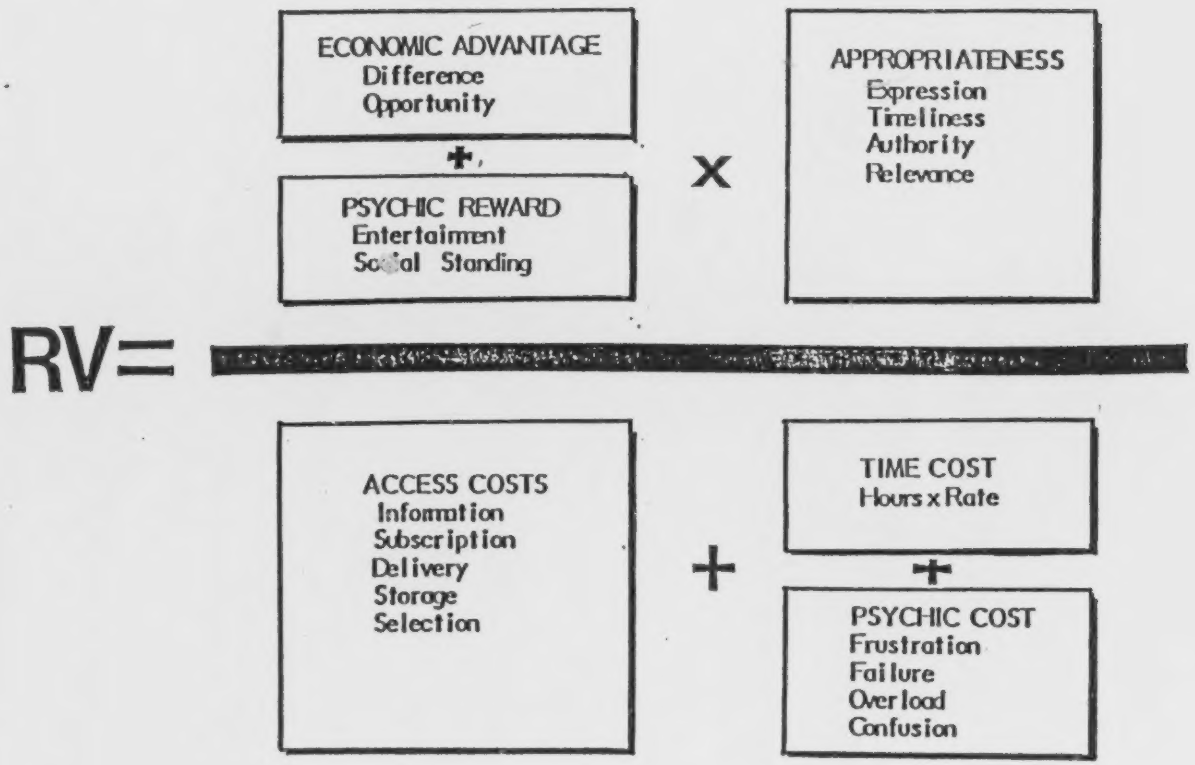
Figure III-1 presents what we believe are the essential components of information value, constructed in the form of an equation to indicate how the components are related. It may not be possible to quantify this construction in any useful way, yet we suspect that something like this evaluation is intuitively considered by information consumers whenever they compare alternative ways of acquiring information.

The benefits of an information product or service are presented as the numerator and the costs are shown as the denominator so that when the benefits are greater than the costs the relative value (RV) is greater than 1, and when the costs are too great the relative value is less than 1.

1. Economic Advantage

The information itself includes—to a greater or lesser degree—the intrinsic value of putting the owner at an economic advantage over others. A traffic report permits the listener to choose a route which will put him at the head of the line. Market research permits the company to design a more popular product. Accurate geologic data may permit an oil company to buy land which no one else believes is worth the price.

At least two major components contribute to this value: (a) **exclusivity** or the degree of difference between what the information owner knows and what is known by others and (b) the **opportunity** of the owner to exploit that dif-



RV=

ECONOMIC ADVANTAGE
Difference
Opportunity

+

PSYCHIC REWARD
Entertainment
Social Standing

x

APPROPRIATENESS
Expression
Timeliness
Authority
Relevance

ACCESS COSTS
Information
Subscription
Delivery
Storage
Selection

+

TIME COST
Hours x Rate

+

PSYCHIC COST
Frustration
Failure
Overload
Confusion

ference. It is no help to be told how to avoid a traffic jam if everyone else gets the same advice. At a certain point in the evolution of new technology every industry stops funding public research and each company begins to seek a differential advantage, working in secret to find the right application first. In a horse race the value of an accurate assessment of the horse's chance increases directly with the exclusivity of that wisdom, and the value is obviously decreased by sharing.

BUT THAT IS PRECISELY WHAT RADIO TRAFFIC REPORTS PROVIDE. THE SAME INFORMATION MAY HAVE DIFFERENT VALUES TO DIFFERENT CONSUMERS.

Of graver consequence is the impact of exclusivity on the formation of capital. An important factor in encouraging investment is the presumption that the investor is better informed than others about the outcome of the enterprise. To the degree that all investors have equal access to information this potential for difference is reduced, along with the incentive for investment.

EXCLUSIVITY IS IMPORTANT ONLY FOR SOME INFORMATION. I DON'T CARE IF YOU ALSO KNOW HOW TO CURE YOUR COLD.

Opportunity is also essential. Consider the hypothetical case of a young Wall Street researcher who overhears a restaurant conversation in which a well known investor describes his plan to takeover a sleepy manufacturing firm. The investor will offer $60 a share for stock now trading in the low 30's. What does the researcher do?

He shares the information with his employer who shares it with a group of investors. Unlike the researcher whose limited investment resources would have allowed him to make only a small profit, the group has the resources to gain substantial value from the information in spite of the fact that all this sharing reduces the "difference". The value of information increases with the opportunity to exploit it.

2. Psychic Reward

Information also contains intrinsic psychic rewards, of which **entertain-**

ment is certainly the most obvious. But the owner of information can also use it to gain attention or greater social standing among his peers by controlling the circumstances under which the information is shared. St. John the Divine begins his Revelations by announcing that he has seen the Doomsday Book and that he will shortly tell everyone how the world is going to turn out, but before revealing his secret he would like dinner and the chance to make a few theological points...

While people seem to have a general bias toward helping each other in this way, the rewards for sharing have traditionally been greatest in the universities where the notion of "selling" information is still regarded with disdain: Cesar Milstein and George Koehler, professors at Cambridge, won the Nobel Prize in 1975 for identifying and explaining monoclonal antibodies. In spite of the obvious financial value of licensing this crucial piece of the emerging biotechnology business, they gave it all away, because they believed like scientists for centuries before them that such information should be shared.

Here we have a critical issue that is felt throughout the discussion of information, intellectual property and copyright: something fundamental to our society argues that knowledge ought to be shared, not sold, and the psychic rewards which come from sharing information frequently eclipse all other costs and values in the equation.

This is so strong a force that we are led to suspect that people seek some information because it can be shared in this way; people read certain journals, attend obscure lectures, buy new novels and look up strange facts because of the psychic value that is imparted by sharing the information with others.

3. Appropriateness

It is clear, too, that the value of information is greatly influenced by how appropriate it is for a particular potential user, and we can distinguish at least four kinds of appropriateness:

Expression: The value of information is increased by being presented in the right language, with efficient illustrations and examples relevant to the reader's experience. Even the messenger is part of the expression. Frank Magid, a television news researcher and consultant who has shaped much of our modern concept of TV news, says that the on-air person must be one whose values and expressions are recognizable and attractive. Otherwise the content of the news itself may not be completely transmitted.

Timeliness: The price of pork bellies last week is not as valuable to a trader as the price of pork bellies this morning, and neither is as valuable as knowing what the price of pork bellies will be tomorrow. Some of this value is related to value of economic opportunity discussed above, but much of it is simply getting information you can act on while it is still true.

Timeliness is also related to the inevitable oozing of information into the public zone. The price of some kinds of information seems to follow the formula:

$$\text{Price} = \frac{\text{Awareness of Value}}{\text{Availability}}$$

When the awareness of the value of a piece of information is very low and its availability is also low, the price that the information can command is low. Who needs it? In time, as the market becomes aware of its value, the price of information increases so long as its availability remains limited.

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Demand exceeds supply. But we often find that still later the price drops again because, although awareness of the information's value is still very high the information has leaked into the public sector and people assume that it can be picked up cheap, or that it no longer imparts economic difference, or that it is no longer true.

ONLY RELEVANT TO CERTAIN TYPES
OF INFORMATION

Nikola Tesla, the eccentric immigrant physicist, is practically unknown in the information age which he, more than anyone, invented. He left an astonishing record of breakthroughs in electronics, inventing alternating current and the radio and developing the fundamental science for robots and computers, satellites, nuclear fission and even missile science. But never was his prescience more obvious than in August, 1893, at the Columbian Exposition in Chicago, where he gave a paper explaining how alternating current could be generated in a way that was far safer and less expensive than Edison's proposal. Although he was applauded as a genius by his scientific peers, the paper was largely ignored because even his wealthy and powerful friends could not see how the theories were to be applied.[2]

When the Treasury Department released its November, 1984 proposal to reform the Federal Tax Code, a publisher of tax information acquired a copy of the publicly available document, called his tax accounting and corporate practice clients and sold hundreds of copies of the document within a few hours at $35 per copy. Within a week the document had lost all but historic value—its contents had been reported in the news media, its impact was well understood and events had already made some of the proposals irrelevant.

Authority: In the information business one of the most powerful attributes of value lies in the authority of the source, and the reason is simple: since the accuracy of information cannot be measured in advance, reputation for accuracy must substitute. Publishers in all media invest heavily to build and maintain this reputation. Several years ago we interviewed police detectives in a number of major cities and asked them how they decided whether to pay a tipster who claims to have valuable knowledge. In most cases the detectives agreed to what is essentially a "subscription" arrangement, and each time paid according to how useful the source had been in the past.

Relevance: Finally, valuable information must be pertinent to the reader's range of interests. Barron's is a weekly newspaper which concentrates on the financial details of Wall Street. For the 260,000 readers who want the data, the one dollar price is not too much to pay, and at least one reader in our experience rides the train in from New Jersey on Saturday morning to get an early copy. In most cases relevance is created by knowing the market's needs, selecting the appropriate material and providing enough additional details so the consumer can, himself, make the final selection.

* * *

The first two values—economic advantage and psychic reward—seem to be additive. Either can contribute value independent of the other. But appropriateness is not additive. Instead it amplifies or reduces the original values. The economic advantage imparted by a piece of information is greatly minimized if the information is in the wrong language, arrives too late, comes from a disreputable source or is irrelevant. Conversely, information can be made more valuable by improving the presentation, the timeliness, the authority of the source and the selection of supporting material.

REDUCED ?.

Every information construction has an associated cost; we suggest that the key components are access, time and psychic cost, each subtracting to a greater or lesser degree from the construction's relative value.

4. Access Costs

Information: The most obvious cost is that of gathering or creating the information divided by the number of parties who are expected to share it. While it is rarely identified as a separate part of the price, most business consumers are aware that this cost is related to the exclusivity of the information. Market research shared by an industry—such as the Nielsen TV Audience surveys—are less expensive than surveys of a station's own audience which it must fund alone.

Subscription: For the majority of the information economy—newspapers, magazines, newsletters, business information services as well as cable television—the consumer identifies his interest in certain information and pays for it in advance. This simplifies the marketing and provides economic stability to publishers who must maintain the information production capability even when the information itself is unpleasant or of low interest. Sometimes the subscription is an exclusive one which limits the number of others who can gain access.

SO A LOT OF INFORMATION IS SHARED.

Delivery: Moving information from the producer's production facility to the consumer can take many forms, most of which are explicit—postage and handling, telecommunications connect charges, a television receiver. But others are less so, including the cost of supporting a public or corporate library and the cost of recording or copying the information.

Storage: Most information products and services are embodied in a medium which facilitates delivery and storage; books, magazines and newspapers use paper and ink, computer programs usually are transported on floppy disks or tapes and movies are embodied in film, tapes and disks. These storage media have very different characteristics, and in the case of microfilm whole industries are built up around the simple conversion of material from one medium to a more cost effective one.

In every case, though, the consumer has storage costs ~~which~~ that may be much higher than the cost of the original purchase. Libraries must catalog titles into their storage system, photocopying requires paper, data storage requires incremental computer capacity and complex database management systems.

Selection: Finally, there is a cost associated with having choices. The most visible example of this is the bookstore which stages a wide range of titles in inventory so that the consumer can make relevant selections, determine the appropriateness of the expression and get a taste of the information itself before buying. To pay for this the bookstore keeps at least 40% of the price the customer pays.

In most cases these costs are bundled together and presented to the information consumer in a single price, a subscription, or an annual service fee. Online information systems, on the other hand, often identify special access fees, computer processing and telecommunications separately, just as cable television charges separately for installation, basic service and tiered services. Disaggregation gives the consumer some flexibility. AND BUNDLING MAY BE A PROFITABLE STRATEGY FOR PRODUCERS).

5. Time Cost

None of the normal pricing structures, however, acknowledge the very high cost of time associated with information consumption. If one values time at, say, $5 an hour then the 35 minutes spent each day with a newspaper costs ten times more than the newspaper itself. The time spent reading a novel can cost two to three times more than the hardback book, and the time a professional spends reading a $150/year newsletter (at $25 an hour) can easily cost four times the subscription.

The cost of time changes from hour to hour depending on the value of the best use of that time, so we see information consumers shifting consumption to less expensive times and placing greater value on media which permit this manipulation. A mother of five children cannot watch an 8 AM television program on child behavior, but with the right equipment she can record it to be played later that evening when there are fewer competing "uses" for the hour. Electronic banking systems offer the value of being available at night when the cost of the consumer's time is lower. The portability of the newspaper permits a commuter to split the cost of his time, and significantly reduce that portion of his information cost. In these and other ways, information consumers choose and use the media in order to gain the benefits of information at a lower cost.

6. Psychic Cost

Like psychic rewards, the costs of frustration, failure, overload and confusion are difficult to understand and impossible to measure. But we know that readers and viewers turn away from information sources they dislike, and will not use online services that are too frustrating or data compilations that are too complex.

The abundance of information, in fact, creates psychic costs of a particular kind, lumped generally under the phrase "information overload", in which the victim seeks to cope with confusion by blocking information from certain sources, by trying to skim the data in hope of grasping the essential point (called "chunking") and by finally resorting to intuitive judgments rather than attempt rational analysis. "Don't confuse me with the facts."[3] Every behavioral scientist who has observed the syndrome describes it as stressful and unpleasant, a psychic cost of some significance which drives consumers away from many information sources.

The problem may becoming more prevalent. Ithiel Pool and his colleagues have estimated that the volume of information produced in the United States grew 27% from 8.7 million words per capita in 1975 to 11 million words per capita in 1980, while information consumed grew only 7% from 45,000 to 48,000 words per capita over the same period.[4]

Managing information overload may have contributed to the last aspect of psychic costs we want to raise here: we have found among managers and professionals a tendency to see information acquisition and processing as a clerical task, not an executive function, and they resist products and services which seem to place them in a lower status—like going to the library, or looking up facts or even reading the regular journals. After a demonstration of one of the early executive workstation prototypes, the president of a major US bank explained that he wouldn't need one. "I have a secretary that does these things." For him the risk of failure and frustration, the social cost of breaking ranks and his perception of how to spend his own time, together created costs that could not be surmounted by the benefits of timeliness, relevance and economic advantage that an online system could deliver.

B. Where Does Value Come From?

Where do these costs and benefits come from? What causes them to grow and recede in the course of building and delivering information?

We've distinguished in Section I between information and knowledge by arguing that one imparts the other. Just as money is one way of transferring wealth and electricity is a way of transferring energy, information, in our use of the term, is a way of embodying and transferring knowledge. This distinction allows us to say that a particular information construction can contain a high or low degree of knowledge, that it can be relatively efficient or inefficient, welcome or odious, true or untrue. It helps us understand that those who advocate a "free flow of information" often mean a free flow of knowledge, while those who are concerned about "owning" information often mean retaining control over the use of a particular embodiment or expression of knowledge.

1. Creation

In this context it is clear that the most obvious—and most important—source of value is certainly the creation of information, the purposeful construction of symbols which permits others to share knowledge. Sometimes this is done by the person who discovered the knowledge, sometimes it is only a reorganization of knowledge into a more visible or more meaningful pattern, most frequently it is both. But here we include observations of events expressed in words, speech, illustrations and music, recorded in many media. Here is the poetry and the software, the novel and the market research report, the painting and the formula for paint.

The creation of information usually contributes much of the benefit of entertainment, appropriateness of expression and authority benefits considered above We usually attribute this creation to "authors" and protect the fruits of this work through copyright and patent law as well as secrecy agreements and restrictions on use.

COPYRIGHT
PROTECTS
EXPRESSION,
NOT
IDEAS (INFORMATION)

2. Conversion

The value of information comes also from converting its form to one that has greater value for the same, or for a different audience. The conversion may include:

- Translation into another language or format
- Presentation in a more appropriate or entertaining manner
- Approval by a more authoritative party
- Embodiment in a different storage or distribution medium
- Construction of access aids such as indexes and abstracts
- Re-organization into a more usable form

Here is that enormous activity that consists of creating a movie from a play, creating anthologies, indexes, news summaries, databases, microfilm, catalogs and compilations. Here we recognize the most significant aspect of the relative value equation—that the same information can have very different value in different forms.

- Mead Data Central retypes the text of all federal and state court decisions in order to make them available online (Lexis) to lawyers who are then able to automatically search the US case law for precedents that fit the situation.

- Congressional Information Service provides federal documents in microfiche along with a complete index and online database in order to help users gain access to government information more efficiently.

- Disclosure, Inc. microfilms all basic SEC documents and sells the microfiche to libraries, enabling them to add this important information to their collection at a fraction of what it would cost in paper.

The effect of conversion is often to reduce the cost of delivery and storage in the case of microfilm, the time cost of access in the case of databases and the problems of overload in the case of indexing and abstracting. Sometimes conversion creates costs while contributing to additional value: the new annotated edition of James Joyce's Ulysses, for example, provides new meaning to the work by putting it in the context of additional information—but it increases the cost of the text tenfold. And conversion can deliberately degrade one value to increase another. Weekly news magazines regularly repeat the daily news a week late, but in so doing they often illuminate the meaning of the events by reorganizing them into a more comprehensible sequence. Charles Kraus, the Washington Post reporter who covered the mass suicide in Jonestown, Guyana in 1979 said he didn't understand what had happened there until he read it a week later in Newsweek.

Conversion creates very significant intellectual property problems. Some conventional forms of conversion are covered by the "bundle of rights" associated with copyright—translation, reprinting and re-use, performance rights and microform or electronic distribution. But when the conversion includes changes in the expression or the re-sequencing of data the rights afforded by the copyright law become foggy and difficult to apply:

o Newspaper stories are often read on radio with only slight changes in the expression, and although very systematic occurrences of this practice have been found illegal in International News Service v. Associated Press, it continues unchecked. The practice is thought by many to be fundamentally fair and consistent with our social objective of sharing important knowledge.

- Abstracts of articles are often created and sold by other publishers without permission or payment. The Information Industry Association, whose members include both the abstracters and the original publishers, has distributed a memorandum[5] in which the distinction is made between "informative" and "indicative" abstracts. "Informative" abstracts capture the essential information contained in the original article and are therefore considered "derivative" works which require the original author's permission, whereas "indicative" abstracts merely indicate the subject of the article and can be produced and sold without permission or payment. The memo does not go on to suggest how one knows when the essential content has been captured.

- Basic data ~~is~~ are often extracted from published works and republished without permission, without payment and frequently without attribution. The market research and consulting industries have raised this to the level of standard procedure and Predicast has made it a business—in their case it is a loose-leaf service which organizes all published statistical forecasts by SIC code and product category.

- The US Department of Defense routinely clips the major newspapers and transcribes the network newscasts, assembling the result into a daily news digest called "Current News" which is distributed widely throughout the government and overseas without payment or in some cases the knowledge of the original publisher.

- Standard Rate and Data compiles the prices and specifications for all US advertising media and distributes this essential information to subscribers every month in the form of large books. Every month Donovan Data Systems uses the books to update their own database of advertising information which they, in turn, sell to the advertising industry as an online service. No permission,

?

no payment, no knowledge.

The conversion of information from one form to another is sometimes considered "derivative use" and sometimes not, and it may or may not infringe on the traditional protections afforded the author or the publisher. In this case we are dealing with what Judge Learned Hand called the "concentric circles of abstraction"[6]-- the propensity for ideas and even some expressions to migrate from medium to medium, from form to form, leaving ownership and attribution behind in a complex eddy of reorganizations and enhancements.

But in most cases these conversions add value. If the same information can have more value in one form than it has in another, then the enterprise of conversion is economically legitimate and inevitable, however troublesome it may be for our current concept of intellectual property. Emerging technologies make new kinds of conversion possible, and our growing reliance on information make them necessary.

WHY?

3. Distribution

Distribution, too, adds value—most directly by bringing the information to the users for whom it has been designed, as in the case of the books and records where as much as 70% of the final price pays for distribution. It is in the less formal distribution schemes, though, that we find more complex economic problems. Sharing mechanisms come into play in order to allow many to sample the information—magazines are passed along, newsletters are circulated, books and records are traded, all because the formal distribution system is imperfect in two respects: (a) it doesn't always deliver the information all the way to one who can best use it (how can best use be known?) and (b) most products and services are sold in a way that makes sampling difficult. Not everyone will buy an information product without sampling it.

It is possible to draw several tentative hypotheses about the value of information and its origin:

1. **The value of information is different for every user.** Because so many of the elements are unique to the individual, there is no point in trying to construct a hierarchy of valuable products and services. Indeed, for each user, the same information has different value at different times. It can change with the social or economic context, change with the time of day, change with the user's mood.

2. **The major source of value in information lies not with the content but with the construction.** The content is usually available in many forms and at least one of them is usually free. What makes some information more valuable than other information is the appropriateness, the access characteristics and the total cost of use (as distinguished from the purchase price)—and these are determined as often by the medium as by the message.

Corollary: value is specific to the intended market. In most cases its greatest value is to those for whom it has been fashioned. In fact it might be argued that the more widely distributed an information construction is, the less ~~the~~ each user will be willing to pay. Economic difference is reduced, expression is less specific and direct relevance is less likely.

BUT IT MAY GENERATE MORE TOTAL REVENUE.

Corollary: The most valuable information is probably that which the user participated in fashioning. Alan Kay has argued that the history of image information has been a series of trade-offs. Movies displaced the theater, television displaced movies and video games have displaced television. In every case we have moved to a lower level of image fidelity and detail but gained a greater degree of control over the medium. Whenever people are faced

HARDLY!

with a choice between having more detail and having more interactive selection, control dominates detail.[7] Another way of saying it is that relevance is more important than precision.

3. The business of information is not so much the production of content as it is the reconstruction of content—transforming content from a relatively low value construction to a high value construction by moving it to a new market, putting it in a new context, storing it in another way, expressing it in another fashion.

If these hypotheses are true, then the information economy is more like the distribution businesses we know than something we don't know. If true then the most critical issue is not unauthorized use but derivative use. If true, then the value of information lies in decentralization, not centralization. It lies in having many forms, not in the economies of scale that come from a single form. We are moving from an industrial environment where value comes from volume production and uniformity to an information environment where the opposite is the case.

WHAT IF A
DERIVATIVE
USE IS
UNAUTHORIZED?

NOTES: Chapter III

[1] 1981 Columbia University Study, quoted in Show Me Libraries, July 84, p. 19.

[2] Margaret Cheney, Tesla.

[3] John Grier Miller, op cit, pp. 164-169.

[4] Ithiel Pool et al, Communication Flows, pp. 48-49.

[5] Ben H. Weil et al., "Proprietary Aspects of Abstracts"

[6] TK

[7] Alan Kay, Presentation at IIA Conference, San Francisco, November 12, 1984.

IV. THE DISTRIBUTION OF REWARDS

Information is offered to the market in a wide variety of packages and in 1984 the market responded by spending $143.7 billion. Where does the money go? We have discussed the value of information and its origin in the conceptual framework of economic advantage, psychic reward and appropriateness, but who gets paid for all this? Who are the participants in the information economy? An adage among investigative reporters may be helpful here: "if you want to know what's going on, follow the money."

The money flows through the information economy in four distinctive streams:

Retail Sales: Books, records, movies and software are sold directly to the consumer, usually through a retail mechanism ~~which~~ that collects a fee in the form of discount and passes the balance through to the producers.

Subscription: Magazines, newspapers, newsletters, cable television and many information services, both print and online, are paid for by the user in advance to gain regular and timely access to a compilation of information products of which some may be more valuable than others.

Sponsored Information: Television and radio broadcasts, direct mail and outdoor advertising and much printed matter, e.g. newspapers, are free to those who have invested in the necessary receiving equipment. The producer is paid not by the consumer but by a third party—the advertiser—who wants an opportunity to reach that audience.

Publicly Funded: Journals and reports, health and safety information, libraries and clearinghouses, public television and even online databases are offered free or at marginal cost by federal, state and local governments in order to achieve certain public interest objectives. As a rule, the costs are shared by all taxpayers, not just by those who use the information.

1. Where the Money Goes:

Information users pay about half the cost of information distributed in our economy—12% of the full $143.7 billion is spent on audio and video equipment, while 33% more is paid for retail information purchases and subscription fees. The advertiser pays 38% of the cost of distributing information and the balance is paid by other segments of the industry for subsidiary rights. (Table IV-1) Within the four sectors, though, the financial characteristics are quite different:

[redacted]

Retail: In the case of books, records, movies, some software and other retail sales items the user pays the entire cost, the retail outlet keeps between 40% and 50%, the producer gets 35% to 45% (minus the cost of production) and the author gets about 10%. Authors of some software packages receive much more. Products have a high marginal profit and a best seller can be lucrative for everyone in the system. This is the only sector where royalties have a major role; the only sector where the market success of the product or service is systematically reflected in the author's compensation.

BUT IT
SURELY IS
REFLECTED
"UNSYSTEMATICALLY"
IN OTHER
SECTORS.

The largest cost for retail products lies certainly in stocking the items at the point of purchase. Books, records, software, videotapes and even movies share the characteristic that the information has to be made easily available prior to purchase. Books and records must inventoried, software must be placed in stock and movies must be exhibited even when the theater is almost empty and the level of purchasing is low.

TABLE IV-1: INDUSTRY SUMMARY

INDUSTRY	Revenue:	Equipmnt	Service	Advertsr	Industry
Books	12012		4384		7628
Magazines	13055		3917	7180	1958
Newspapers	29350		7925	21426	
Information-Print	10985		10985		
Information-Online	3650	548	2792		310
Document Retrieval	660		660		
Direct Mail	13000				13000
Radio	7013	1964		5049	
Television	22172	8425		13747	
Cable	5954		5418	536	
Motion Pictures	9647	1254	6280		2113
Records & Tapes	6100	2196	390		3514
Performing Arts	4070		4070		
Software	6000				6000
TOTAL	143668	14387	46821	47938	34523
% Distribution	1.00	0.10	0.33	0.33	0.24

	Expense:	Creation	Conversn	Distrbtn	Profit
Books	12012	1744	1374	8294	601
Periodicals	13055	2236	1537	8106	1175
Newspapers	29350	4691	4691	15272	4696
Information-Print	10985	3248	1083	5007	1648
Information-Online	3650	533	1024	1764	329
Document Retrieval	660	76	97	461	26
Direct Mail	13000			13000	
Radio	7013	1192	1296	4244	281
Television	22172	2402	3326	11566	4878
Cable	5954	835	872	4008	238
Motion Pictures	9647	1073	716	6835	1023
Records & Tapes	6100	841	1345	3286	628
Performing Arts	4070	1058	317	2532	163
Software	6000	2000	1000	3000	
TOTAL	143668	21929	18678	87375	15686
% Distribution	1.00	0.15	0.13	0.61	0.11

Manufacturing is the second largest cost—28% of revenue for books, 10% to 15% for records and movies, yet in nearly all cases producers use ~~commercial~~ independent manufacturers rather than integrate vertically.

Although it is the smallest component of the cost, editorial may be the most critical to success. Book publishers often succeed or fail on how well they select and present their books. Software companies succeed by attracting products appropriate to the market. Movies succeed by combining the right material with the right directors, actors, cameramen and producers to create a compelling motion picture. In the case of book publishing, editorial employees receive a salary based on tenure and position while in the software and motion picture industries they are much more likely to be rewarded for the different impact and quality of their talent.

Subscription: In the case of newsletters, online services and most cable television, the user pays the full cost, but in newspapers and magazines, half to two thirds of the expense is shouldered by advertisers. Although subscription pricing produces a more stable revenue stream, marginal profit tends to be lower and circulation and acceptance by the intended audience remain critical in covering costs and making the service work.

Reaching the right market efficiently is the largest fraction of the cost for newspapers, magazines, cable television. In online publishing, 62% of the revenue is spent for sales and distribution. Both magazines and newspapers, for example, spend more on circulation sales and fulfillment than they receive from the consumer. Systems and communications costs absorb 23% of the online publisher's revenues and 11% of the cable industry's ongoing revenue, not counting depreciation of the massive capital investment required by both.

Manufacturing, is usually done by the producers themselves because of the importance of production control and timeliness, though in the case of magazines the printing is purchased from outside firms.

Sponsored Information: Broadcast radio and television provide a rich and fundamental supply of news and entertainment to our society. **As a result, for most information consumers, most information is free.** The broadcast media in this country are sometimes criticized for seeking mass audiences by providing "least objectionable programming" instead of using the medium to lead or enlighten the audience as European broadcasters seek to do. But despite this characteristic of the system, radio and television have come to play a far greater role than newspapers in equalizing access to information. Along with schools and libraries, the broadcast media provided a limited safeguard against the danger that as information becomes more highly valued the poor will be left behind.

At the same time the availability of so much free information would seem to place pricing pressure on competing media like movies, books and records. Yet we find no indication that this competition is now a concern; the other media have adapted and survived. People who hear a song on the radio will nonetheless buy the record; people who see a movie on television develop an appetite for more of the same and often rent or buy video tapes of the same programs.

BUT SURELY THERE HAS BEEN A SIGNIFICANT IMPACT. PREVIOUS CITE TO EFFECT OF TV ON MOVIE-GOING.

Publicly Funded: It is impossible to do anything but guess at the amount of state and federal money spent each year providing information to the public. At least $10 billion is spent in support of scientific and technical research and dissemination, NOAA, National Bureau of Standards, National Geological Survey, IRS, Government Printing Office and other agencies whose primary purpose is information. In all likelihood it is more. No one knows.

No one knows the full range of of federal government information programs either. Matthew Lesko, an independent researcher, calls the federal government the "world's largest supplier of computerized databases and data files" and estimates that over 3,000 such files may be available for public access,[1] but there is no directory or even group of directories which offer a comprehensive list of available government publications.

There is no apparent policy to determine how products should be produced, priced or distributed and no organization within the government claims oversight. While the Department of Defense puts technical information on the controlled commodities list, the National Technical Information Service sells a third of its reports on government funded research to foreign companies and governments. The National Geological Survey sells maps and gazetteers which the private sector repackages and sells at ten times the price back to the federal government. Publications are distributed free, sold at marginal cost and sometimes priced to be competitive with the private sector because the federal government has no single set of guidelines governing how publicly funded information should be shared or how its cost should be allocated.

* * *

Where then does the money go? 55% of all information revenue we have identified is absorbed in the process of sales and distribution, 15% is spent converting the information to a form appropriate for the intended market and only 17% is spent on the content itself. To restate this in the context of our earlier discussion, the information industry appears to be primarily involved in converting knowledge into an appropriate information form and delivering it to a market where it is highly valued. Relatively less is spent developing the knowledge itself.

2. The Stress of Change

The mechanisms through which information is sold are changing, the rules which govern commerce in this area are ambiguous, and in some areas producers claim to be experiencing losses as the result of unauthorized copying. The notion of property has become more difficult to define in an age when the authors can't always be identified, and the popular concept of what is "fair" or "just" gets caught between the old beliefs about libraries, science and the virtue of sharing on one hand and the modern reality of exclusive information services and very expensive software constructions on the other.

Looking back across the production and distribution systems we have described, it is possible to see several areas where shared use, free use, fair use and unauthorized use are creating real economic stress:

Theft of Service: The fact that television is free simply makes a virtue of a necessity. There was no way to charge for it. But several other information delivery systems can be accessed free and, although unauthorized use normally subtracts little from the value delivered to any other user, it deprives the producer of incremental revenue.

- It is possible in some cable systems to bypass converters and scramblers in such a way that the user can receive pay cable services without the authorization or knowledge of the system operator. Like the "blue boxes" used to access long distance telephone networks, this theft of cable service is illegal. It usually requires wiring modifications which would be apparent, but unlike the "blue box" its use cannot be detected or traced from the system.

- Pay TV services consisting of premium movies and sporting events are also delivered over the air in some cities by low power microwave transmission which can be intercepted in some locations with antennas that cost less than $150 to install. The existence of these antennas can normally be determined from the street and individual violators have been successfully stopped in the courts.

- Online information services are available to anyone with a personal computer, a communications modem and a password. From time to time those passwords become available to others, and it is even possible in some cases to break into an online system without a password, but use of online information services this way is considered theft of service and is illegal. All use of online services creates a record of usage that normally results in a charge to the owner of the password, so while the data security issues of such a breach may be very significant, the financial losses are usually not.

Unlike copying and derivative use, there is no confusion about theft of service. It is widely recognized as an illegal practice even though the resulting revenue losses have been so far hard to measure.

HAS BEEN
CONTROVERSY
OVER RIGHTS
OF SATELLITE
EARTH STATION
OWNERS TO
INTERCEPT
TRANSMISSIONS.

Copying: As long as it was more expensive to copy an article, a record, a movie or a computer program than to buy it or borrow it, people conformed with the law. But with the decline in cost of photocopiers, tape decks, tape and diskettes, users must choose between what is "legal" and what is obviously inexpensive, convenient and not specifically prohibited. Several issues create this stressful circumstance:

- The concept of **"fair use"** is not always clear to users who have difficulty understanding why some kinds of photocopying are legal and other kinds are not. Why can they tape "Superman" off cable tv but not copy the same movie from a tape they have rented? Why can they copy some videogames—in fact they are often *given* pubic domain copies of video games with their first computer—yet not trade games with others in a club.

BETAMAX CASE DOES not ADDRESS COPYING OF CABLE TRANSMISSIONS.

- The first sale doctrine appears to allow the book purchaser to copy chapters and give them to a friend, yet not to allow the same rights to the purchaser of a video disk.

NOT AT ALL CLEAR!

- Schools and libraries, which users encounter at an early age, actively promote the ethic of sharing knowledge. Libraries appear to lend books, records and videotapes without any fee. They copy microfilm, books, magazines and government publications, put machines in the hall to permit their patrons the same privilege, and when the document, record or videotape is not available the library will happily borrow it from a library network for the *purpose* of copying.

- Schools routinely tape television broadcasts and exchange those tapes with others. Teachers at all levels copy chapters out of textbooks, novels, magazines and map atlases and hand them out.

- Subscribers to online databases discover that as they search and retrieve bibliographic citations or statistical series or the full text of an important article on their computer they can *copy* it to a diskette. (This is called "downloading".) They are accustomed to making copies of messages, programs or other material they are working with and, in fact, at a typical cost of $100 an hour for online access, it would seem imprudent *not* to copy the results of the search. It isn't even illegal. But database publishers are concerned that this practice will lead to fewer online searches—in theory the user can download the whole database once and never sign on again. If off-air taping for time-shifting is permitted, users ask, why shouldn't downloading be?

- Piracy continues in all media as individuals and companies copy books, records, videotapes and software for the purpose of selling them on the black market, in other countries and even through legitimate retail outlets. Piracy is hard to detect and harder to stop, and both tasks are made more difficult when certain kinds of copying become legal.

Derivative Use: The most difficult aspect of re-use comes from legitimate publishers who abstract or reorganize the works of other publishers and enter the market with a derivative work. All information products are derivative to the degree that they draw on earlier expressions and ideas, and we have argued here that a major function of the information economy is precisely the reorganization and enhancement of existing information to make it more valuable to a specific market. On the other hand an orderly information market would seem to require that the producer have the exclusive rights to sell his version of the information (his creation or conversion) for a period of time.

Abstracting is governed by the fragile distinction between informative and indicative abstracts.[2] Those abstracts which exist primarily to help researchers find an article are "indicative" and therefore legal, while those which contain the main elements of the article are considered "informative" and therefore require permission from the copyright holder of the original work, since one of the rights of copyright is the right to control derivative uses. The logic is persuasive but the distinction is hard to draw.

HAS THIS DISTINCTION BEEN ACCEPTED BY THE COURTS ?

In practice this means that any article of 200 words or more can be abstracted without permission so long as the abstract does not quote extensively from the original. Shorter articles and items in newsletter are considered already so concise that any abstract would inevitably informative.

3. Who are the authors?

Much of our notion of intellectual property and the exchange of information includes the concept of an author whose creativity should be encouraged and whose rights to attribution, integrity and a fair market must be protected. If that is a true and valid concept, then somewhere in each system we should find rewards flowing to an author or to a group of authors.

Retail: It is easy to identify the author of a book or a computer program, less so the author of a record or a movie. And yet we can trace the ways in which these systems identify the primary contributors and share the reward among them. Since many of the participants are outside the producer's structure, contracts and licenses are written ~~which~~ that begin by attributing authorship and then establish a clear royalty formula for sharing the revenue.

Textbooks are more complicated since in many cases they are originally conceived by the publisher and often written by employees. The "author" is frequently only an authoritative advisor and his share in the revenue is less. THAN ?

Movies begin with a story for which an "author" is usually paid, and then other authors begin to write, and rewrite. The final screenplay may be in large part the work of the producer, or the director, or the studio head, or even the star. At each turn of this process new agreements must be made providing a fair share of the revenue and the attribution, all of which is captured in successive deal memos.

In the heyday of melody it was easy to spot a song by Irving Berlin or Johnny Mercer, but few song writers retain their commercial identity today when the recording artist or producer can so completely alter the product's destiny.

We think of the author as the one who gave the idea its expression, but in every sector of the information business we find examples where someone else has contributed more in the conversion to another medium. The addition of minor material or the quality of the performance may have had the effect of re-authoring the material, lending it new meaning and lifting it to a new level of significance. Who is the author now?

Subscription: In magazines, newspapers, newsletters and other information services the problem is even more complex. While many consumer magazines include contributions from individual writers, most of the material is written by employees. At news magazines, a story is normally written by several.

At most newspapers the function which gives the product it greatest value is throwing stories out. 2,000 stories arrive every day at a major newspaper and choosing which 1,900 should be discarded—a kind of "negative" authoring—largely contributes to the product's identity and relevance.

In a separate study of newspaper content in 1983, we analyzed the degree to which five representative newspapers owned or had authored their content. On average the newspapers ran 104 stories each weekday of which only 40 had been written by the staff. The rest were from unidentified wire service employees, and occasionally from other unidentified newspapers. The newspaper has one-time publication rights to this material and while it may edit the stories, it cannot add to them or republish them in any way.

Newspapers buy the weather information, sports scores, TV listings, comics, columns, horoscopes, stock market listings and photographs from various wholesalers, and in each case get only one-time publication rights. Freelancers submit long and useful pieces with the note that the same article or some subsequent version may appear in another newspaper or magazine. Publications regularly draw on each others material with and without attribution and businesses as well as individuals often find to their frustration that a simple error in one published story will echo through the press for years.

In this hurly-burly of derivation and counter-derivation the identity of the author gets lost, the integrity of the story is often injured and revenue flows to the most skillful packager. Yet no one has ever argued that reporters and writers lacked incentive to produce under these circumstances in part, we suspect, because such individuals perceive themselves not as authors but as members of an "author-team": editors assign stories, reporters get the quotes, copy editors check facts, writers turn a phrase, photographers get a head shot, librarians add perspective. **Locke's view that an author "owns" the fruits of his labor may be true, but how is it applied to the modern phenomenon of an author-team?**

Sponsored Information: Television has raised the idea of authorship to yet another level where it is frequently referred to as simply "programming". Networks buy most of their content from individual production companies, not from authors. Within the production company it is easy to find "writers", but who is responsible for creating the information construction that is half an hour of video entertainment? The copyright, which we have thought of as an incentive for authors, is held by the production company and, as a practical matter, the company is the author.

Local radio and television broadcasters also produce "programming", in the form of a news show or an evening magazine, but again the writers and the on-air performers are all employees; the copyright is held by the company; rarely can an individual in any capacity be identified as the "author".

Direct Mail, which at $13 billion a year in 1984 certainly qualifies as an information business, has no "author" except the company.

Outdoor advertising—about $1 billion 1984—has no "author".

In all of these examples we are tempted to conclude that the owner should be called the author except, of course, that we started by asserting the reverse. WHERE?.

Publicly Funded: The distribution of information is a major function of government, but beyond that there are advantages to the sponsoring agency in distributing information which might lead to a better understanding of its activities. In most cases the information is distributed as widely as the funding will allow through a number of mechanisms including the Superintendent of Documents Office, the National Technical Information Service and the agency's own public relations program.

Although the government does not copyright the information it produces, authorship is normally attributed to the agency ~~which~~ that sponsored the work. Individuals are rarely named and then usually promptly indemnified.

From time to time the government contracts with private organizations to produce information and, while the practice in such cases is that the contractor delivers all rights to the government, exceptions are made which allow some contractors to retain "rights in data"—the right to re-use and re-sell the information it gathered at government expense.

* * *

Where are the authors? Our search is an unsatisfying one. There are many writers, artists, composers and poets to be sure, but most of the information in our economy is created by employees who work mainly in teams and who rarely experience any of the rights or benefits which the copyright law intended to confer. Attribution is normally to the source publication, not to the writer. Liability rests with the company ~~which~~ that created the product. ~~Marginal~~ Profits flow for the most part to the investors, not to those who found the data or organized the presentation or crafted an efficient expression.

If by "author" we mean the person who had the primary impact on the information structure, then in movies, television, radio, direct mail and even some newspapers and magazines we are talking about directors, producers, assignment editors and others who may never pick up a pencil or a brush.

The complexity of our information constructions have led us to author-teams and the demands of video and electronic media have raised this to the level of author-companies—program production businesses for whom the word "author" has no useful meaning. The money does not flow to individuals except in a few rare cases, and neither do attribution or liability. We no longer live in a world where the most important information is created by individuals; information is no longer a business of authors and books.

- WHAT IS THE IMPLICATION? FACTORS OF PRODUCTION MUST STILL BE REWARDED REGARDLESS OF WHAT THEY ARE CALLED.

NOTES: Chapter IV

[1] Matthew Lesko, Federal Database Finder, p. 1.

[2] Steele, Goldberg et al, "Abstracting" TK

V. PUTTING INFORMATION TO WORK

Who uses information and why? At the end of Communications Flows, Ithiel Pool suggests a distinction between "information for work" and "information for living"[1], and while a few products like The Wall Street Journal might properly be assigned to either class, there are fundamental differences in how information is used in each case.

A. Business Information Use

1. Characteristics of Usage

Ezra Vogel begins his book, Japan as Number One, with a long and laudatory description of how Japanese businesses use information:

> "If one examined all the research institutes, universities and government and private research organizations in America studying any given issue, it is likely that the sum total of basic information would surpass that in Japan. (But in Japan information) ...is a group directed process closely linked to long range organizational purposes, permitting an impressive range of information to be concentrated where and when the organization can use it.[2]

And later:

> "Japanese loyalty and patriotism are not inherited but are constantly recreated by organizational practice, and perhaps no practice is more important than the shared search for more information and the optimal solution to which it leads.

Nothing illustrates Vogel's point more eloquently than the fact that a consortium of Japanese engineering companies will contribute $18 million to the cost of cleaning up the wreckage of Three Mile Island in return for access to all pertinent documents and records related to the accident.~~[4]~~[3] Japanese businesses aggressively and systematically seek information as a strategic resource and they tend to develop it themselves and keep it secret from others. In the United States, on the other hand, information is bought and sold in an open market that encourages innovation and permits even the smallest users to gain relatively low-cost access to the knowledge pool.

This difference helps explain why the U.S. supports a large and rapidly growing business information industry (about $14.6 Billion in 1984) while Japan's industry is scarcely visible and in Europe the industry is less than $4 Billion.[4]

But the same tendency to think of information as a commercial service instead of a private resource contributes, Vogel suggests, to relatively lower levels of skill among U.S. businesses in understanding and integrating information. U.S. users seem less sophisticated about information processing and analysis than their Japanese counterparts and rely to a greater degree on the skills and authority of the supplier. They "buy" rather than "make" what they need.

Vogel's observation helps us to see a second usage characteristic: **business information in this country is still used more frequently for cost displacement and control than for strategic gain.** Of the three uses, **cost displacement** is the most primitive--a newsletter, for example, saves the cost of attending conferences, subscribing to other journals or supporting outside advisors. Many businesses still think of information and automation primarily as ways to eliminate labor costs.

"Control" means newsletters and trade journals, technical papers, internal reports and memoranda, market research reports and office communications that are used to reduce waste, to avoid mistakes, to convey instructions, to catch up with a condition and to gain reports on the effect of action. Control of information permits a business to manage more complex activities but it often inhibits precise maneuvers. Imagine an automobile that had, instead of windows, a bank of video displays connected to cameras all around. At moderate speeds along a straight road the automobile would be manageable, but one can envision how difficult it would be to drive up several levels in a parking garage and put the car safely between two white lines.

In reality, using information to manage business is worse than the windowless car: (a) instead of a steering wheel and pedals the driver has a keyboard at which he enters commands and (b) there is a variable delay in the video circuit: the front screen shows what the camera saw several seconds ago while the rear-view display is always perfect and slightly magnified.

In spite of its imperfections, control information can reduce the cost of observation and increase the span of control, making it possible to manage routine functions more productively.

Strategic use of information has quite different potential, though, and usually means systematic prediction of the environment, rigorous intelligence gathering and modeling of a planned action. Instead of reporting the past or present as a guide to response, it looks forward in time and guides initiative. It is much more expensive because of the detail and precision required and the payoff can be substantially greater, but the information requires a great deal of sophistication to manage since it includes hunches, assumptions, and projections as well as observations, and is usually processed in technically complex ways.

Vogel's comparison of Japanese and American approaches to information only hints at the third important usage characteristic: while Japanese businesses gain control of information at its origin and dedicate trained resources to processing what they have gathered, American businesses tend to put the burden of information integration on each individual worker. It is as if every worker had to manage his or her own piece of the company finances—handle the purchasing and payables, bank loans and profit distribution that result from that particular job. The result is just as chaotic, particularly for traditional printed information.

WHY IS CENTRALIZATION NECESSARILY BETTER ?

2. Managing Print Information

Special studies, episodic papers and specific technical data with the greatest value are normally acquired and kept by individuals because, we suspect, the value of economic advantage and the psychic rewards associated with exclusive knowledge are far greater than the social rewards offered by the organization for sharing and disclosure. The information is also lost, although this kind of organizational forgetfulness also offers the advantages of forgiveness which Hannah Arendt calls the key to action and freedom.

Most regularly published print information, on the other hand, is purchased by individuals and small operating groups and circulated through the organization. The information thus often loses timeliness, and because the distribution is irregular it loses the value of being dependable. Reference material is usually purchased and managed by the corporate library, if one exists. The premise on which this whole system operates is that each person will read and remember relevant information. He might copy or clip articles of special interest (thus interrupting the circulation of the journal around his group) or do research by reading through back issues of relevant journals or using the annual index. But that premise is false.

HOW ?

The post-Sputnik renascence of American science provoked a surge in the supply of primary technical information which was met and managed in large part by the invention of secondary information tools—indexes, abstracts, information clearing houses and research databases for the scientific and technical community. Most of our business information industry had its beginnings in that watershed period. But now the cure threatens to be as troublesome as the illness; we are flooded with secondary tools.

In a recent survey of several thousand engineers, researchers and knowledge workers in one of the countries largest corporations, we asked what was the most serious information management problem they faced. 39% said timely retrieval of published information—information they had already paid for but couldn't access easily for lack of useful indexes and appropriate systems. 19% said that getting information from their own company was the biggest problem, keeping track of other projects, prior work, available resources and related activities. 17% complained of overload—too much mail, too many trivial messages or too many journals required to monitor a particular field. 22% said their biggest problem was managing their own files of information that they had seen and were trying to work with.[5]

Few if any said that the information they needed was incomplete, or inaccurate, or poorly written, or insufficiently creative. Quality is not the problem. No one complained of secrecy or even the lack of systematic coverage of any subject by a conventional publisher. The information exists. What they said was that the last leg in the distribution process has collapsed under the weight of traffic. Their organization and their own lack of information management skills have created almost insurmountable obstacles.

Conversation with fellow workers was rated a more valuable source of information than journals and technical papers, in large part because this informal network helped direct the user to the right external information.[6]

Senior executives in high technology companies tell us that they can't keep up; they operate less on data and more on their intuition. They repeat experiments unnecessarily, build inappropriate products and rely on conversation instead of the formal information channels now choked with publications. Business librarians and information specialists have neither the responsibility nor the authority for the way their company employs information, and executives search for but have not yet found a new structure.[7]

Business information users face a profound and complex resource management failure that has blocked much of the potential value that this abundance of information forms had promised.

3. Managing Online Information

The hope for many years has been that online search services would provide the access tool that would make the vast journal literature more readily available, and in fact we estimate that as many as 50,000 organizations now regularly use Dialog, BRS, Mead Data Central's Nexis, and other services to access the estimated 2500 databases now available in the United States[8].

According to an analysis published by Frost and Sullivan[9], 40% of these databases consist of abstracts, brief summaries or limited bibliographic information about journals, technical papers and other sources. These represent access tools to help users find published information more quickly. 6% of the databases consist of full text--they are the source material. 54% of the databases are statistical and numeric, serving as primary reference tools.

Of the users, 61% describe themselves as researchers, students or faculty, suggesting that in 1984 **the online services offer retrospective research facilities to intermediate users, information specialists and scholars.**

On average users spend $100 an hour for access to these services, and gave as the primary benefit, "timeliness"—immediate access to information when they needed it. In fact, the data ~~itself~~ themselves are not always current. Less than a third of the databases are updated weekly or more often and at least 42% are updated only quarterly.[10]

A look at the most heavily used databases, however, hints at the changes to come. The Frost and Sullivan research indicates that Lexis—a full text database of state and federal laws—is used twice as heavily as the next most popular database, Chemical Abstracts, a classic scientific research tool. Reuters, Quotron, Telerate, Dow Jones, and Standard and Poors together had revenues of over $500 million in 1983 providing online services directly to investors who are dialing up from terminals and computers at their own desks.

60% of the database publishers responding to the Frost and Sullivan survey said that new online services would have a "shrinking" to "devastating" effect on the print publication of reference books and trade journals, with a much lesser impact on trade books and general magazines.[11] **Online information services are shifting from a secondary research tool for information specialists to a primary information source for millions of knowledge workers.**

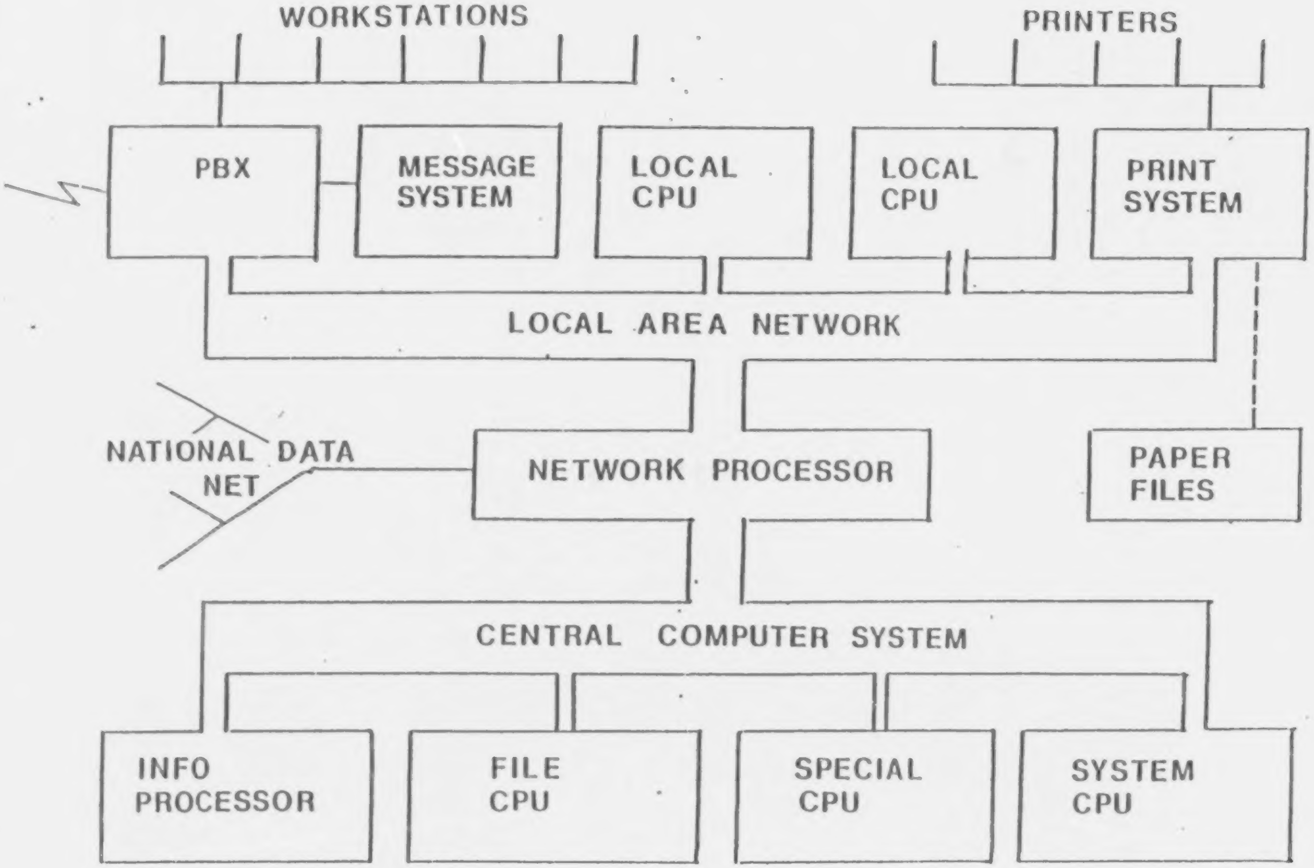
Three forces are converging to cause this shift: (a) personal computers and video display telephones will become normal tools on the desks of most information workers within the next decade, (b) more databases will be developed to include full text, telephone directories, electronic mail, comprehensive information "maps" to other sources and even expert systems to aid in monitoring the hourly changes in the information flow. (c) Users will realize the importance of direct access and rely less on work done by an intermediate.

The advantages of online information are not only direct and timely access. The technology we expect to emerge in the future business environment (Figure V-1) increasingly will allow users to integrate external online services with their own internal data under a common subject organization so that both domains could be searched with a single command.[12] While this has very significant benefits for users, it presents a pricing problem for database publishers who, until now, have charged for access according to connect time. With new technology, though, users can dial into a database and download large segments of the file into their own system. They pay once for access and are then free to store it and use it repeatedly for as long as they wish.

Online systems are not the whole answer to the challenge of putting information to use in business. New organizations are necessary to permit team information processing and different rules about information resource management can are required for broader sharing. Like the Sorcerer's Apprentice, businesses must manage the new abundance of information or be drowned by it.

Government is struggling under the same enormous burden. At the State Department 1 million messages a year are turned, because of the current information system, into 144 million pieces of paper to be transmitted, read and filed. In spite of an earnest effort to introduce better document management systems, it now takes several days to move a routine message from one office to another. Aside from the staggering cost of supporting this system there is the unmeasurable cost in performance—and the risk of failure—that comes from information systems operating so near the point of collapse.[13]

FUTURE NETWORK ARCHITECTURE


WORKSTATIONS
PRINTERS
PBX
MESSAGE SYSTEM
LOCAL CPU
LOCAL CPU
PRINT SYSTEM
LOCAL AREA NETWORK
NATIONAL DATA NET
NETWORK PROCESSOR
PAPER FILES
CENTRAL COMPUTER SYSTEM
INFO PROCESSOR
FILE CPU
SPECIAL CPU
SYSTEM CPU

In the long run we are confident that business and government organizations will adapt to this situation by organizing themselves to manage this resource more effectively. A few companies—and a few nations—will come to understand information as a strategic resource of great significance, and others will follow them out of the current confusion.

B. Personal Information Use

Since the second world war U.S. households have spend a more or less constant 3% of their disposable income on information[14]. Even the shift from print to electronic media has been slow and steady, indicating how much of our information consumption is habitual. According to their respective industry associations, the average adult spends 202 minutes a day watching television, 165 minutes listening to the radio, 34 minutes reading a newspaper and 12 minutes reading a magazine—or about 7 hours a day consuming information.[15] These numbers can be understood in a real sense only by recognizing that the television and radio figures include time when sets are played in the background and not actively listened to or watched.

The authors of Communications Flows estimate that the average American consumed 45,000 words out of the 11 million that were "offered" by print and electronioc media each day in 1980. In Japan the average individual consumed 23,000 out of the 1.5 million offered.[16] In any language that is a prodigious amount, equal in volume to this report. Why do people do this?

Elihu Katz and his colleagues searched the literature on mass communications and found 35 different information needs which they classified into five rather theoretical groups:

1. Cognitive needs: related to learning
2. Affective needs: aesthetic or emotional experience
3. Integrative needs: increasing confidence, status and stability
4. Social needs: strengthening contact with family, friends and the world
5. Escapist or tension reducing needs[17]

Leo Bogart says it more simply:

> People "seek inspiration, amusement, instruction and a sense of participation in the great events of the time. But above all else, the media experience is a pastime, an activity that people engage in at certain hours of the day when they have nothing of overriding importance to do, and when they simply want to relax from chores or evade boredom."[18]

For businesses we have seen that information is a way of reaching across time to recover prior experience or predict future conditions, and through space to monitor and control distant operations. We have seen that while information presents very difficult management problems, it is less costly in time and resources than travel, direct observation or experimentation. Paul Zurkowski calls it a "counterpart" to reality that is more easily examined, transported and modified.[19] Bogart, too, suggests that information exists largely outside of time, and claims that is its charm.

A startlingly different view is offered by Jerry Mander in his angry book, Four Arguments for the Elimination of Television. For most of us, he says, information has mediated reality, divorced us from primary experience and presented in its stead a reconstituted version, with and without laugh track. He says that individuals have become increasingly dependent on information and have no independent knowledge of the world. That leaves us more vulnerable to the risk of incomplete or biased reporting:

> "We find ourselves living inside a kind of nationwide room. We look around it and see only our own creations.

> We go through life believing we are experiencing the world when actually our experiences are confined within entirely human conceptions. Our world has been thought up.
>
> Our environment itself is the manifestation of the mental processes of other humans. Of all the species of the planet, and all the cultures of the human species, we twentieth-century Americans have become the first in history to live predominantly inside projections of our own minds."[20]

Of course, it isn't our minds running the projector, it is the minds of the producers. Perhaps the strongest theme in the literature on personal information is a fear that in one way or another those who produce the information we consume might misrepresent reality and, because of their apparent power, gain an unhealthy influence over individual values and public opinion. The antidote proposed is usually enforced diversity—reduced concentration of media ownership, legislated provisions for "fairness", "equal time" and "access" along with government and community support for what are perceived as valuable but less popular services.

Unfortunately diversity is antithetical to the economics of the mass media where size of the audience is the major determinant of profit. It has been even more difficult to achieve because the historic scarcity of spectrum, the high cost of production facilities and the licensing requirements at the federal, state and municipal level which have presented high barriers to competition in television, cable and newspapers. Yet over the years we have struck a tenuous balance between these competing interests in the United States and, using a variety of regulatory and economic tools, achieved a supply of personal information which is the richest in the world, the least expensive and the most diverse. Notwithstanding the larger risks that Mander describes, we have achieved an economics of abundance.

HOW DOES THIS RELATE TO EARLIER DISCUSSIONS OF EXCLUSIVITY AND VALUE?

WHAT ARE THE LEGAL BARRIERS TO NEWSPAPERS?

It is difficult to measure the impact of information on the individual user, so much of it seems to be, as Bogart put it, a "pastime". Advertising information frequently has direct impact on net worth, and in fact magazine and newspaper readers often list advertising as the most important component of the media package. In 1977 the Newspaper Advertising Bureau launched a research project to determine what information people found most important, and 78% said "best food buys". 75% said health, nutrition, medical advice and consumer news. Other useful topics appeared on the list: Home repair, 58%; personal finance, 54%; Home furnishing, 49%; TV reviews and schedules, 49%; and Personal advice (Dear Abby) 36%.

In addition to these practical subjects, people listed areas of general interest where one would expect the information to have less impact: Human interest stories, 75%; Political figures or public officials, 67%; Sports, 59%; School news, 56%; Sports or show business people, 49%.[21]

From time to time information can play a pivotal role in the household's welfare—warnings of danger to health or safety, reports of opportunity beyond their immediate sphere, lucid instruction in something of direct importance. Once in a great while entertainment achieves the level of art, setting life on a new course. But these are the fruits of serendipity. Households do not systematically acquire information so much as they scan the horizon. And, like the businesses we have considered, households have only the most primitive methods for research and retrieval.

Online Services

Over the past five years several efforts have been made to build online information systems for the home but none of those experiments has been commercially successful. Dow Jones has certainly achieved the most success with 120,000 investors accessing the special purpose database from personal computers.[22] The Source and Compuserve have signed on 45,000 and 93,000 subscribers, respectively, to a service for computer hobbyists that offers games, limited software, discount purchasing and bulletin boards as well as the daily news wire. While these businesses seem viable, their markets are specialized and their growth has fallen far short of the personal computer installation rate.

The Prestel system in England, the CAPTAIN system in Japan, Bildschirmtext in Germany, the Viewtron system in South Florida and the Times-Mirror system in California have all offered interactive systems with excellent graphics and a wide assortment of services including shopping, book reviews, airline bookings, news, banking and portfolio analysis, detailed weather and do-it-yourself medicine, but none of these services has attracted any market.

At the end of 1984, nearly 6 million personal computers had been sold in the United States. At least 500,000 have been equipped with communications modems[23] and we estimate that as much as $100 million may have been invested in building interactive consumer services, and yet no commercially sound system has emerged for the home. It is possible that such systems will become popular, but the successful format is not yet visible.

One interesting development is worth noting: whenever an interactive system is installed in a household the message portion of the system becomes immediately popular. The busiest feature on both The Source and Compuserve is "chat" which permits users to exchange advice and comments live at their computers, or to leave messages for each other on electronic bulletin boards. When Viewtron created a community bulletin board the users quickly learned to use it as a local crimewatch system. Users begin reporting the news to each other, seeking each other out as experts, linking up in an informal processing team to combat overload and media occlusions.

In Literary Machines, his unorthodox tract on the evolution of very large databases, Ted Nelson has suggested that because of this technology people will become their own publishers. With the appropriate message systems, households will build and maintain their own information systems covering subjects of real interest to them.[24] Individuals will write and file stories, maintain databases, report school committee meetings and neighborhood schedules, make political statements and indulge in the same low humor and personal opinion that has until now been the private preserve of sports columnists.

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Nelson suggests that the new technology will reduce the clout of publishers the same way publishers reduced the influence of the church and state—by disintermediating them. **The significance of the publisher as watchdog and arbiter may be reduced and the role of formal information products like newspapers, television broadcasts and "letter reports" from local agencies will be lessened by an open network in which the whole community participates.**

C. Obstacles to Use

A supply of appropriate information products and services is necessary but not sufficient to our objective, which is that information be available at the lowest cost and employed to its fullest value. At the end of this chain of rapidly changing systems and high technology is a person whose information processing capabilities may be limited by education, by personal resources and by his own views of the world. These are significant obstacles to the proper functioning of the information economy, and while they are less tractable than technology, adjustments are possible. .

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Literacy

Much of the information we need in our personal and business lives is coded in written language, but for a significant portion of the United States population, the code cannot be cracked. According to the "Adult Performance Level" study in 1975, 16% of whites, 44% of blacks and 56% of Spanish-speaking adults were functionally illiterate.[25].

There are many widely-ranging estimates of illiteracy in the United States, but nearly all of them agree on two conclusions: (a) at least 50 million persons—20% of the population—simply cannot read or write. (b) This is a higher level of illiteracy than we find in most European countries, higher than in Japan or Russia with whom we compete politically and economically, and at about the same level as Cuba.

Much of the general news and entertainment in our society is available on television and, as a result, certain rudimentary information needs are met. But illiteracy prevents these people from participating in and benefiting from the information age; to a profound extent the new technologies and the new dependence on information will leave them in the dark backwaters of ignorance.

We can only speculate on how this will effect employment and economic growth: many of the jobs which have offered safe haven for illiterates in the past will in the future incorporate computer terminals, presenting screens of data and calling for responses. Factories, office security systems, retail stores, virtually every clerical task and even some farming tasks will employ computer controlled tools and rely on internal message systems for coordination. Some of these information technologies can be made simple—but on the whole we are designing a future for the literate.

Access

A less significant but more frequently considered issue is whether lack of access to the more sophisticated information tools will deny the poor those rights to health, safety and equal opportunity for education which society has historically tried to ensure. Normally the issue is exemplified with the question of how the average person can afford $100 an hour to search an online database. In most cases, new information tools merely improve access—the information itself is available in many other, less expensive forms. But in some cases less than equal access is equivalent to no useful access. A house with a phone can call the doctor or the fire department while a house without a phone cannot. It isn't enough to say that the poor can run down the street.

Does this happen with information? It might, but it hasn't yet. The impact of the information age has really not been felt by the average household or even by the average private person, other than at his place of work. Interactive information systems for the home are possible, but all the experiments to date have failed to find the formula for success. Computers are in most schools and any child who is interested can usually gain access to one, but we sense no major impact of information technology on education yet. We are convinced that these technologies will have an impact on safety and home security, on health care and on education, but for two reasons we conclude that the risk of denying the poor access to valuable information is no greater in the new technologies than in the age of books and magazines:

The equipment required for access will become cheaper. Manufacturers currently anticipate fully functional personal computers in a few years at a price no higher than a black and white television. MSX technology now being offered by the Japanese personal computer manufacturers may not be the answer, but it points the way to standardized operating systems and mass produced components which in turn will greatly reduce the cost of personal computers.

The more popular the service is, the cheaper it will be. The very high cost of current services largely reflects their specialized nature and the narrow audience that supports them. Such costs would be true in any medium. But the electronic medium has even lower marginal production costs than print —though not lower than television—and we can expect that when the demand for message services, security services, bulletin boards and household information expands to include even the poor, the price of those services will be scarcely greater than the cost of a local phone call.

Cognitive Screens

There is a last obstacle to use which is both real and permanent: some things have to be believed to be seen. Behavioral science tells us that dissonant information is rejected at three levels[26]. When a person encounters information that is inconsistent with his own view his first reaction is to ignore it. The reason is that inconsistent information creates what psychologists call "cognitive dissonance"—either the inconsistent data has to be remembered as an exception to the person's view, thus making the view less tenable, or the view itself has to be changed, a process which invariably requires complex revisions of interpretation and belief. Ignoring data is especially easy, and almost inevitable, if one is experiencing overload, or if the information arrives in an inappropriate form—wrong language, wrong time, wrong supporting material or irrelevant focus.

If the data cannot be ignored, ~~it is~~ they are disbelieved. Reason is found to reject the information because of the source authority, internal inconsistencies, improbable assumptions or false data. A popular tactic for achieving disbelief is to call for more data, making consistency even less likely and increasing the possibility that the whole problem can then be ignored.

Finally, if the information is received and believed it is often forgotten, the last best defense of a tidy mind. Forgetting is made easy by difficult storage and retrieval systems, and it is tolerated in organizations with a loose, decentralized view of information. The premise is often that if the information is important or represents a strong consensus within the organization it will "bubble up," but in practice "bubbling up" usually takes more time than the situation should permit.

There are organizational, process and presentation antidotes to these problems, but one key is to maintain a diversity—not redundancy—of information sources: information from different sources is less likely to be ignored, different formats and presentations increase the chance of being believed and different timing may reduce the chance of the information being forgotten.

The implication is important—whatever economies of scale there may be in mass media, in centralized databases and in information processing networks, these directions tend to reduce diversity, increase the risk of a monolithic error and make less progress is serving a population with different biases and points of view. BUT LOWER PER USER COSTS !

NOTES: Chapter V

[1] Ithiel Pool et al, Communications Flows, p. 73

[2] Ezra Vogel, Japan as Number One, p. 50

[3] Christopher Burns, "Three Mile Island: Information Meltdown"

[4] "European Information Industry Report", Business International

[5] From a private survey of 5000 engineers conducted by Christopher Burns, Inc. in December, 1984.

[6] Burns survey, op cit.

[7] Interviews with 17 high technology industry executives to determine information management needs. Christopher Burns, Inc., August, 1983.

[8] User estimates based on subscriber populations published in IDP Report, Knowledge Industry Publications. Number of databases estimated by Cuadra Associates, Wall Street Journal, January 15, 1985

[9] Online Database Systems Market in the United States, Frost and Sullivan, 1983

[10] Ibid.

[11] Ibid.

[12] Future Information Processing Technology - 1983, NBS Special Publication 500-103., National Bureau of Standards.

[13] Interview with Mr. William Price, Director, Foreign Affairs Information Service, U.S. State Department.

[14] Maxwell E. McCombs, "Mass Media in the Marketplace", Journalism Monographs 24:5-6, August, 1972.

[15] The Media Book, p. 524

[16] Ithiel Pool et al, Communications Flows, p. 16

[17] Elihu Katz, et al, "On the Use of Mass Media for Important Things", American Sociological Review, 38:2, April, 1973.

[18] Leo Bogart, Press and Public, p. 112

[19] Paul Zurkowski, "Information Counterparts,"

[20] Jerry Mander, Four Arguments for the Elimination of Television, William Morrow, 1978, p. 66.

[21] Leo Bogart, op cit, p. 214

[22] Subscriber numbers are based on the IDP Report, Knowledge Industry Publications, 1984.

[23] Business Information Markets, Knowledge Industry Publications

[24] Ted Nelson, Literary Machines, Nelson Publishing, 1981 pp. 2/34-2/43

[25] Jonathan Kozol, Prisoners of Silence, p.2.

[26] Werner J. Severin, et al, Communication Theories, p. 154ff.

VI. FUNDAMENTAL CHANGES

Jacob Bronowski, writing about the impact of technology on our society, sets the stage for the last phase of our discussion:

> "More than a million, perhaps two million years ago, the hominids went from using rudimentary tools (which the chimpanzee does) to making them and keeping them for future use. That discovery, that simple lunge into technological foresight, released the break on evolution which the environment imposes on other animals, and sent man off breakneck at a speed unmatched in the three billion years that life has existed on earth. For without that discovery, evolution is necessarily held down to the pace of biological adaptation. But from the time of the basic human discovery of the future, the environment ceases to set the pace, which instead is then set by the capacity to store knowledge and form plans from it."[1]

Change has many patterns, but the one most commonly associated with technological change is a pattern of plateaus: first the tools become visible. Today, technology brings forth crude models intended for a task that we can only, in some cases, imagine. After a pause to understand the tools and experiment with their application, we find appropriate uses—not always those the technologists had in mind. And finally, after a period of accommodation, we discover that our lives have changed in very fundamental ways.

All three levels of change are visible now:

A. New Tools

The evolution of **computer technology** continues at an incredible rate as scientists find ways to pack more and more complex circuits onto smaller and smaller chips, cutting the price at the same time they increase the processing speed. Microprocessor technology forecasts indicate that the rate of improvement experienced since 1970 will continue for another decade.[2]

In the last ten years we have seen this result in a rapid expansion of computer tools at the very high end and at the very low end. Super computers capable of 100 million floating point logical operations per second (MFLOPS) prepare the way for parallel processing of scientific, military and real time information on a scale that permits artificial intelligence to be applied to practical problems. At the same time, the technology has been packaged in small, general purpose "personal computers" which have been rapidly accepted by business as a way to bring routine processing capability to the work site without the organizational cost of dealing with a central computer facility.

o In all likelihood the continued evolution of computer processing power will lead to a second product mitosis in which the **personal computer** evolves upward in functionality toward an even more powerful workstation at the same price, and downward toward a common communication and processing station (we now think of them as "terminals") which would cost only a few hundred dollars and be ubiquitous within a decade.

o At the same time we expect the current, primitive digital networks to expand greatly in scope and flexibility until virtually all office workers have access to **electronic information exchange networks** capable of image as well as text exchange (Figure VI-1). Routine inter-office communication will be electronic even though, for ergonomic reasons, paper may be preferred "display" device.[3]

These processing/communications networks are likely to be built for personal use as well. If the lessons of videotex ~~are projectable~~ can be projected, the application of this technology ~~which~~ that is most valuable to private persons and households lies in the direction of message and bulletin board systems that link people to each other.

o The drum beat of technology drives us not only toward more and more diverse uses of computer processing and communications power, but to altogether new ideas about "processing" itself. From Charles Babbage to Visicalc, we have thought of computers as logic processing machines, restricted to the high speed sequential performance of steps leading to a predetermined solution. But **expert systems technology** (or "artificial intelligence" to use its stage name) suggests that systematic inference processing can be designed to solve simple problems, and to provide valuable assistance in more complex situations.[4] The early successes in this area, coarse and juvenile as they sometime seem, nonetheless require that we now anticipate a world in which many routine information processing tasks are automated.

o Among the tools we will find in the future there are certain to be much **higher resolution audio and visual display** devices including television screens, data display, audio reproduction and voice synthesis along with the satellite and fiber optics distribution systems necessary to bring new entertainment and information services into the home. At this stage it isn't clear how those services will evolve or what impact they might have on such traditional media as television, radio and newspapers.

B. New Uses

So far we have found three major ways to apply the new technology to the information management tasks we know:

o **Communication:** Notwithstanding the great discovery of "data processing" in the 1970's, we believe the more pervasive impact of the new technology will be on business and personal communication, providing for a faster exchange of detailed information within an organization. Word processing and electronic message systems are the immediately visible aspects of this application, while voice processing, teleconferencing and very intelligent digital and image exchange networks lie ahead. This use does not come about only because it is possible, but because increases in knowledge cause increases in specialization which, in turn, require increases in information exchange.[5]

HOW DOES THIS RELATE TO PREVIOUS DISCUSSION OF JAPAN?

Size alone does not determine the information exchange needs of an organization (or, as James Grier Miller points out, an organism).[6] It is not simply a matter that larger companies need proportionately more complex information systems. The current trend toward increased management precision, longer range of anticipation and a greater degree of central integration are major elements in forcing higher and higher information exchange needs.

o **Storage and Retrieval:** We have observed how serious is the current problem of information retrieval within organizations; we can only imagine how that condition will be aggravated by an increase in the rate of information exchange. Information technology offers a number of hardware and software tools to combat this organizational equivalent of Alzheimer's disease, including the integration of external and internal information and the potential for expert systems to deliver major breakthroughs in knowledge management.[7]

This is not only a business problem. As a large and complex nation competing at the leading edge of science, we waste an unknown but probably significant fraction of our resources because we lack the tools necessary for the prompt exchange and retrieval of experience. It is worth repeating in this context that the problem is not one of "ownership" but of finding an appropriate exchange mechanism.

WHAT DOES THIS MEAN?

It seems ironic that as a society we will spend so much effort over the next few years to limit the distribution of a few information products in order to increase revenue for their producers when a far larger issue of sharing non-proprietary knowledge is at stake.

o **Processing:** The technology permits not only the routine processing that we have come to think of as synonymous with computers, but also the knowledge-based inference processing that expert systems promise. We may come to see processing as something that happens not only at the terminal or the mainframe, but in the communications switch as well and even in the channel.

This processing is at once the greatest promise technology makes for the future and the source of our most stubborn information property problems. **In its extreme form it will be hard to distinguish from the kind of creative work we have called "compilation" or even authoring.**

At the University of Pittsburgh a graduate student has created an expert system ~~which~~ that writes routine news stories about such financial events as the price of gold, and does it so well that a panel of judges could not distinguish the machine-written stories from those appearing in the local newspaper. At Yale University, Roger Schank, G. de Jong and their colleagues have devised a program which can "read" stories from the newswire and restructure them in coherent statistical fashion.[8] (There is no indication that the two programs have yet been plugged into each other.)

Processing is what permits us to parse the ideas or data in an expression or statistical series and reorganize them into a perfectly legitimate alternative language or presentation, and while there are still real and possibly intractable limits to automatic language processing, much more can be done in a practical way before those limits are reached. The integration of multiple databases, newswires, reference data and messages seems in the future to be limited only by our ability to imagine applications.

C. New Ways of Living with Information

As information becomes a greater part of our personal and business lives, three changes seem to happen: (a) information management becomes an explicit task for every worker, not just for librarians, researchers and specialists; (b) We begin to use information, as Bronowski suggests, to anticipate the future and shape our strategy and (c) Information grows in importance to challenge direct observation and experimentation.

AGAIN, HOW
DOES THIS
RELATE TO
DISCUSSION
OF JAPAN?
SEE V-4

o **Information for the End User:** Our information management tradition has been largely industrial, relying on specialists to gather and evaluate the information we need—the press plays that role in our personal lives, and a poorly structured research and library apparatus plays the role in the business. Our experience, though, has taught us that information is altered in this process. Reporters, editors and the culture of the press struggle to find the "meaning" of an event when in fact there are usually several different meanings. Information specialists, by contrast, search for a "scientific" way to select and transport information in a meaning-neutral system that often eliminates the elements of intuition, hypothesis and interpretation. Neither works.[9]

For better or for worse, the technology and the times are moving the task of information management directly onto the desk of the end user who can then gain access to the primary material and find his own meaning, follow his own hunches and integrate the external information with his own knowledge and intuition.

We believe that in the most critical information situations, information processing teams will emerge. Many years ago, Arthur D. Little, Inc. under contract to the Department of Defense, sought to identify those characteristics that led to successful research and development. Prominent among the conclusions of the study was the observation that "adaptive" organizations are more successful at this information intense task:

> "This means that critical decision making is not confined to the top of the pyramid but is diffused throughout the organization according to each man's ability to contribute wisdom where he has knowledge, experience or talent...Communication is not through channels since who is at the top of the decision-making hierarchy depends on the content of the decision.[9]

Information is an alternative to hierarchy, and as individual users gain greater access to information and information networks, it is likely that their organizational and political structures will change.

Information as a Strategic Resource: This shift in access is closely linked to a shift in the nature of the information being accessed. In the past individuals, organizations and communities have thought of commercial information largely as a record of **observations,** but in the future it is more likely to include **communication** with peers and constituents as well as systematic **predictions.** And there is a very significant difference to be observed between this kind of information and the kind around which we have constructed most of our property laws. WHY COULDN'T PREDICTIONS BE COPYRIGHTED ?

The phrase "Information Age" is rarely used to mean an increase in novels, movies, or videogames. It means observations processed by expert systems in the context of prior internal and external data. It means complex communications within communities and organizations. It means inferences and predictions that are the result of a new information handling technology.

To be sure, individuals will use the new equipment to look up abstracts of articles, but the conclusion we reach is that new information uses are being transformed from consumption to communication. It is less a product and more often a process: reference publications that were purchased and cataloged in the past will in many cases be replaced by online services that provide the basic information in the context of an expert system which helps the user find the data, choose a product, or even complete his own calculations.

Some trade journals will be effected by the existence of industry news networks and bulletin boards which facilitate the "publication" of papers, the sharing of data, the announcement of new products in a searchable database, along with several levels of news, background and basic text.

Novels, which became movies, may someday become games.

The idea of an information "package" which solved so many of our problems several centuries ago may not be the best intellectual model for the newest and fastest growing aspect of information. In business, science, health care and government—and prospectively in future home information systems—the role of the author and the publisher, even the role of the printer, is being disintermediated by technology, and the package has become increasingly a "connection."

PUBLISHER'S NOTE:

The following pages are unavailable for filming:

VI-9

[1] Bronowski, Jacob, "Technology and Culture in Evolution," *American Scholar*, 1972.

[2] "Future Information Processing Technology", p. 27ff.

[3] Christopher Burns, "Paper on the Brain", also Paul Strassman, *The Information Payoff*, p. 176

[4] McCorduck, *Machines Who Think*, pp. 273-301, also Feigenbaum and McCorduck, *The Fifth Generation*, pp. 33-61.

[5] Strassman, *op. cit*, p. 10.

[6] In very large animals, for example, the brain may be relatively smaller in proportion to the body mass, but the autonomic nervous system is usually more highly developed, just as local information exchange systems and "politics" are much more sophisticated in very large organizations.

[7] Nelson, Ted, *Literary Machines*. There is no particular chapter on the subject on how technology will lead to very large data bases—book itself is entirely a description of that vision. For a broad, well informed view of how these databases might evolve, James Martin, *Telematic Society*, pp. 199-210. Or for a less benign view, David Burnham, *The Rise of the Computer State*, pp. 49-87.

[8] The system is called FRUMP (Fast Reading Understanding and Memory Program) and has apparently also created summaries in foreign languages.

[9] Two of the most important science fiction works of the last decade have included proposals to remedy this problem. In *Stranger in a Strange Land*, Robert Heinlein creates the idea of a "Fair Witness", a professional information manager who is value neutral and whose purpose it is to report exactly what happened. In *Dune*, Frank Herbert creates a similar person called a "Mentat" who is trained from birth to tell it like it is. Both are poignant expressions of our need, but reveal an equally touching ignorance about how information really works.

VII. ISSUES IN THE INFORMATION AGE

We have been considering the changes that come with the onset of the information age, and in this chapter we will consider the impact of such changes. But to regain our equilibrium and perspective, it is useful to recognize those things that will remain on a relatively steady course.

The fact is that most of the information economy we have considered will change only slowly: while newspapers may decline further in economic and social significance, their continuation seems assured for decades to come. Television may, like radio, grow more local in content and in advertising while premium channels and even new high resolution services gain the prime time national audience, but the medium has great audience loyalty and financial resilience. Books and magazines may see some services erode as the result of online information systems but these, too, are changes in share of market and not sudden discontinuities. Of the $143.7 billion economic segment we have considered, most of the change is centered on the evolution of business information systems and the growth of consumer electronics and computer-related services for the home—certainly less then 10% of whole.

Whatever may be implied by the changes ahead, most of our current information structure will continue for a long time into the future, and will require that we maintain a vital and appropriate copyright law and unambiguous rules for the commercial exchange of traditional information products and services.

A. Shelter, Voice and Equity

The positive potential for new information products and services in our personal lives is considerable: we can expect better educational tools for our children as well as life long educational materials for ourselves. We can expect access to health-related information and assistance that may genuinely change our lives by helping us monitor and correct conditions while they are still within the normal range.

We can expect higher resolution entertainment, both audio and visual, with limited interactive capabilities. The newswire will be available on demand, at different levels of detail and tailored to the interest profiles of different members of the family. Shopping, banking, message exchange and even voting are all technically possible, and descriptions of these activities crowd our current literature, each more breathless than the last.[1] Invention is not the mother of necessity, and the early models of these services have been uniformly ignored. But technology is relentless, and in time all these things will come to pass.

1. **Shelter:** Information technology offers systems that permit better monitoring of home safety and security. Expert systems software will certainly ring the fire alarms of the future, answer the door, set the temperature and, in at least one current system proposal, water the plants. But we must have the shelter of privacy as well, and as David Burnham points out, privacy is an endangered condition.[2]

Information does not jeapordize our privacy because we are made to reveal more and more personal data, but because the information we have already surrendered is being processed more rigorously. The very trend toward better information management that holds out such hope for business will permit us in the future to assemble thousands of personal details that people long ago, and in a different world, agreed to make public: social security number, address, checking account number, automobile registration, purchasing preferences.

Sears maintains a database of nearly 50 million credit card holders—including all the information we have voluntary provided. They can overlay that data on the demographic characteristics of people in our neighborhood (U.S. Dept of Census), automobile information (local registry of motor vehicles), demographic and lifestyle characteristics (from warrantee card information on 15 million homes, now centrally processed by a small Denver company), magazine subscriptions (available from a major direct mail list house), job title and employer information (data bases compiled from yellow pages, industry, professional and public telephone directories) This combination of data is extremely valuable because it allows companies to market their products more specifically.

The primary obstacle to getting the data is simply the technical complexity and computer processing demands of mixing different public databases that are in different formats. And that obstacle is going away. How can we recapture the privacy of information we long ago gave up? How can we outlaw certain kinds of processing when they are so difficult to detect? How do we prevent such systems from feeding on the data byproducts of electronic funds transfer, direct mail pharmaceutical sales, public opinion polling and interactive entertainment purchases?

2. Voice: In Technologies of Freedom, Ithiel de Sola Pool mounted a sustained and elaborately documented argument—a cry from the heart:

> 'For five hundred years a struggle was fought, and in a few countries won, for the right of people to speak and print freely, unlicensed, uncensored and uncontrolled. But...as speech increasingly flows over those electronic media, the five century growth of an unabridged right of citizens to speak without controls may be endangered."[3]

Pool's argument is that because the telecommunications highways of the future are scarcer and more complex than the printing presses of the past, they may continue to be regulated. Access will be controlled, and even content will be monitored—those conditions prevail today. The trend to deregulation of the broadcast media, coupled with the breaking up of AT&T may have turned us onto a different course, but the terrible vision remains—that because of the power of the new media, society will be less forgiving of provocation and dissent, less tolerant of lewd and reckless speech, less willing to endure the noise and heaving to and fro of special or privileged interests.

At the same time, Pool offers us another vision of information exchange, born of the new technology, which has very different characteristics, particularly in the area of copyright. The printing press stabilized the language, created canonical literature—the concept of *idea authorities*—and empowered a few copyright holders to express those ideas in a particular way. Others may disagree, but the economics of publication placed a high price on any debate. As A.J. Leibling once said, "the power of the press belongs to the man who owns one."

Pool suggests, as others have, that electronic publishing networks are more likely to resemble the process *before printing presses* when individuals used a manuscript as a basis for their own exploration and comment, when a variety of views co-existed.

> 'Electronic publishing returns us to those traditions. A small subculture of computer scientists who write and edit on data networks...foreshadow what is to come. One person types out comments at a terminal and gives colleagues

on the network access to the comments. As each person copies, modifies, edits and expands the text, it changes from day to day.[4]

But how would the copyright law keep up? (Pool takes as given the notion that copyright protection is necessary as a means for assuring compensation.) The task, he says, is to design "new forms of market organization that will provide compensation and at the same time reflect the character of the new technology."

Ted Nelson has a suggestion:

> "Since publishing can be instantaneous and unrestricted, merely a "publish" button on the console could do it, but the dangers of rash publication to the individual's reputation and career could be great. Some formalized technique would therefore be required...probably a ceremony and a signature.
>
> "An author who wishes to render his work available, but...retain the right to withdraw it at any time...designates his document as private with unrestricted distribution."[5]

BUT HOW IS
THIS
ACCOMPLISHED
IF OTHERS
HAVE "COPIES"?

Nelson goes on to describe "privashing", as he calls it, and while the details of his royalty mechanism may not be acceptable to everyone, he makes his point: computers are very good at bookkeeping. The real problem is a larger one. As science and technology move toward these "privashing" networks we come full circle to the original problem with information exchange: what rights, if any, does a person have to his ideas, to his expression of those (or others') ideas, to those contributions he is able to make in the ongoing evolution of knowledge?

Pool says a new era of information exchange is upon us, Nelson says computers can handle the record keeping, but our practices in the area of intellectual property protection are fixed on the notion of "expression", and are weakest of all in dealing with derivative works, data bases and "private" material—precisely where the most significant action will occur.

3. **Equity:** As a society we are committed to political, educational and judicial systems which favor equity over efficiency, and in the information arena one of the great instruments for equity has been the public library. Ben Franklin started the first library in Philadelphia as a way for a group of friends to share their books, and in time the group of friends became the whole community, the books were purchased out of a common fund and anyone who belonged to the community could read. The impact that simple scheme has had on this country is immeasurable.

REALLY ?.

But the cost of information is rising with its complexity: access to databases cost $100 an hour, newsletters cost $200-300 a year, reference works and looseleaf services can cost as much as $1000 a year. Libraries, whose budgets have not been growing nearly as fast, are prompted to seek several remedies. (a) The government should expand its information activities both through publication and subsidy in order to assure that citizens have the basic information they need. This has been largely in contradiction with federal policy for the past several years.

(b) Libraries should charge fees for certain services and position themselves more as a "public utility"[6] Authors and publishers, spotting a breach in the public library wall, have called for "author's lending rights"—a mechanism for charging the library patron a small fee each time a book is borrowed. Presumably the fee would be split with the library.

ALREADY DONE
IN GERMANY .

(c) Libraries should expand inter-library networks as a way of increasing their (virtual) holdings without increasing their costs. Up to a point this works well, but for many patrons the delay imposed by the network is discouraging.

AND WHAT
ABOUT
"AUCTION." ?.

It is a time of confusion and concern. Library schools are being closed even as those skills are in greatest need among businesses. Professional librarians watch the private sector turn libraries into businesses, but they are unsuccessful in gaining adequate funding from their own constituency.

The library community is accused of being behind the times, but their efforts to find a new role in the information age are also criticized and the debate continues. We have argued before that, with some exceptions, new information constructions do not make knowledge inaccessible to the poor, only more accessible to the wealthy. Because of public libraries the opportunity to become informed remains available to all. But if, in our search for a new way to support them we lose our grip on the idea that they should be free, then the damage to equity will be fundamental.

Will information injure equity by offering employment only to the "computer literate"? Unlikely. The growing use of new information services and technologies may, like the growing use of other tools, change the nature of jobs, but primary impact of more relevant, precise and predictive information, more expert systems and better tools for finding appropriate data will be to eliminate those jobs that are information drudgery. James Martin foresees a wired world of leisure and individual opportunity in which the spirit of diversity and creativity, considered counter-productive in the industrial age, is once again permitted to flourish![7]

2. Changing Value

The primary value that information delivered was embodied in its content—novels, poems, philosophy, essays on medicine and mathematics all captured and transported the knowledge of others. So it was content that we protected.

The vector of change, though, now points toward process. While much of the information landscape will remain familiar, the portion that is changing is that portion devoted to adding value to content through conversion and distribution. Sometimes value is added by businesses, as in the case of secondary publishing. Sometimes it is added by intermediate services like document retrieval companies, online services, video cassette rental stores and libraries. Sometimes it is added by the consumer or his agent—we photocopy articles, swap software, integrate external data and build derivative newsletters.

But the law is unclear about the ownership of the value added. The copyright law begins with the premise that the right to reproduce and distribute information in any way belongs to the original author, and then it proceeds to make explicit and implicit exceptions. The law says, moreover, that the author can claim rights to some works that are "derived" from his:

> "(Section 101) A work based on one or more preexisting works, such as translation,...abridgement, condensation, or any other form in which a work may be recast, transformed or adapted. A work consisting of editorial revisions, annotations, elaborations, or other modifications which, as a whole, represent an original work of authorship, is a 'derivative' work."

But technology and the need to manage information more effectively drive us beyond "translations, abridgements and condensations" toward the re-assembly and integration of several information products. When this is done commercially by database vendors there is a well established practice for recognizing ownership and value added. The owners ~~of the~~ original material license the database vendor to resell the material in combination with other material and the vendor takes a service fee which can be as high as 85% of all receipts. Since the vendor is the one collecting the revenue, the execution is simple enough. Usage is tracked by the computer and records are kept of how many times the publisher's original material is searched, displayed or printed out and the publisher is paid a share of the total royalties in proportion to the use made of his materials. As Nelson says, computers are good at record keeping.

Without the current protection of author's rights to derivative works, as ambiguous as it is, this market accommodation would not be possible. The problem is that we are pushing deeper and deeper into new forms of derivation, and with each step we raise again the question of what rights, if any, the author can claim to the ideas (or data) contained in his work. The law is incomplete in its treatment of value added, and to a great extent, that is where the future value is coming from.

3. The Gatekeepers

Copyright is a limited monopoly granted to authors and their publishers that permits them to control the primary distribution of their work. It does not permit them to control subsequent sharing, lending, storage and retrieval and other functions embodied in the so-called "first sale" rights. But primary control, coupled with the right pricing formula, is enough to assure appropriate compensation, attribution and control over the integrity of the product. Copyright holders are the information gatekeepers.

The changes we foresee introduce a new class of gatekeepers—the system operators—and raise some troubling questions about who is responsible for what.

The National Oceanic and Atmospheric Administration has become the primary source of weather information in this country. Private businesses process NOAA data and develop specific forecasts, but NOAA is the basic source. Last year the Sea Fever set out for Georges Bank, and sank in a storm where none had been expected. The fishermen's families sued the weather service, which responded by claiming that some of its equipment was not working well and, anyway, the fishermen should not have taken the forecast so seriously. The courts disagreed, and said that in this case the system operator was responsible.

Up until now, publishers have been liable only for distributing material that is intended to do injury. Time Magazine prevailed over General Sharon because it acted without malice. But the NOAA case, if it stands, raises the possibility that system operators might be held responsible for diligent processing if not for accuracy. When medicine became a predictable technology, malpractice emerged as a legal concept. As information becomes an more integral part of our personal and business lives, the court seems to be saying, someone has to be responsible for it. And as the court begins to view processing as a source of risk it raises the possibility that processing might also be recognized more clearly by our intellectual property laws as a source of value.

NOTES: Chapter VII

[1] James Martin, Telematic Society, p. 125. Martin compiles a list of all the applications that have so far been imagined. Joseph Deken has written a book about the list: Electronic Cottage.

[2] David Burnham, The Rise of the Computer State

[3] Ithiel de Sola Pool, "Technologies of Freedom, p. 1.

[4] Pool, op cit., p. 213.

[5] Ted Nelson, Literary Machines, pp. 2/36-2/37.

[6] The library fees controversy is best treated in Harry M. Kirbirige, The Information Dilemma, particiularly chapter 5. But see also Donald W. King et al, Key Papers in the Economics of Information.

[7] James Martin, op cit., p. 175.

Economic Issus Relating to New Technologies and Intellectual Property

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PREFACE

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SUMMARY

The introduction of new technologies may have significant economic effects on the markets for intellectual property. Because intellectual property is a public good, the conditions required for its efficient supply are unlikely to be attained through the operation of private markets. Efficient supply requires both that different prices be established for different consumers of the same intellectual property, and that exclusion of non-paying consumers be easy. Neither condition is likely to be fulfilled. Moreover, production will occur in markets that are monopolistically competitive, where firms have market power because they provide differentiated products but entry of new producers is relatively easy. As a result, there may be either too much or too little "variety" in the intellectual property that is provided.

Because of the difficulties faced by producers of intellectual property in excluding non-payers, its production is often supported by advertising or by "bundling" intellectual property with other (private) goods. Advertiser support is likely where exclusion is impossible, or where there are legal restrictions on other methods of support, or where the intellectual property serves as a particularly effective advertising vehicle. Bundling is likely where there is a private good that is complementary to the intellectual property and where the producer of the intellectual property has an advantage in producing it. Other things equal, direct sales to consumers are more likely the lower the price of the intellectual property, the higher the cost of forming a group to share it, the easier it is to exclude non-payers, the more feasible is price discrimination among users, and the greater is the ability of producers to raise prices when sharing occurs. Support from government and non-profit sources also exists.

The introduction of new technologies can significantly affect the behavior of producers of intellectual property. Technologies that permit copying can either benefit or harm producers and consumers depending on, among other things, the costs of producing and distributing copies privately. New technologies, and the declining

costs of telecommunications and computer storage, permit users to download entire data bases to be searched later at their own convenience. Finally, computer software is increasingly being developed by firms that do not manufacture computer hardware, and by users themselves. In each case, producers can be expected to adapt to technological developments by changing the prices of their products, altering their product mix, adopting technologies that make copying or downloading more costly, and/or bringing legal actions against patent or copyright infringers.

The legal treatment of the various "stages" of the production of intellectual property, authorship, publishing, packaging, and distribution may also affect the efficiency of the production process. In the absence of legal restrictions, contractual relationships between authors and publishers, as well as those involving other participants, will be designed both to achieve a division of the risk of success between the parties and to assure that each will expend his "best efforts." So long as the legal system permits the rearrangement of rights through contract, and contracting costs are not too great, regardless of how rights are initially assigned the same objectives will be achieved. Only where there are legal impediments to contracting, or where transactions costs are high, will this fail to be the case.

Technological developments that permit derivative works to be more easily developed may present problems for producers of intellectual property. So long as all such works are produced within a single firm, or the production of derivative works can be detected easily, no special problem arises in their legal treatment. However, derivative works are increasingly being produced in ways that cannot easily be detected and where, as a result, the legal rights of creators cannot be enforced. One possible effect is to increase the extent of vertical integration in order to make more difficult the development of derivative works by those other than the original creators.

A number of published estimates of the harm to producers of intellectual property resulting from unauthorized uses made possible by new technologies have been published. The principal estimates are those prepared under the auspices of trade associations of audio and visual materials. Each of these groups claims substantial harm resulting from widespread unauthorized copying.

However, these estimates fail to specify the behavior of producers and consumers in the absence of unauthorized copying. In particular, they do not specify what prices would have been charged for originals if there had been no copying. The result is that the counterfactual against which current behavior is being compared is not carefully specified, and the resulting estimates may either overstate or understate the resulting harm. An alternative method for estimating harm, based on a model of consumer and producer behavior when a copying technology is introduced, may overcome this shortcoming.

Various methods are available to promote the supply of intellectual property. Defining private property rights and requiring rights holders to protect these rights through legal processes is a widely used alternative. Its principal limitations are that many kinds of infringements are not easily detected and that, because the harm from each individual infringement is often small, the use of collecting societies is frequently required. The latter creates the risk of anti-competitive behavior by rights holders.

A number of countries have imposed, or permitted to be imposed, levies on copying machines or media, to compensate rights holders for new types of infringements made possible by new technologies that are difficult to detect and prevent. The royalty fee may be set by the government, or by negotiations involving performing rights societies, or the government may permit private negotiations but reserve the right to limit the fee. Private establishment of fees may permit anti-competitive behavior while the government will not often possess the information needed to set fees appropriately.

Direct government assistance is often employed to support the production of intellectual property. However, in the absence of market signals, government may have considerable difficulty in determining whether to support particular types of production and the amount of support to provide. This means that government support should probably be confined to basic research where the extent of market failure is likely to be greatest.

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1. THE SIMPLE ECONOMICS OF INTELLECTUAL PROPERTY

Intellectual property is an archetype of the economist's public good. According to Samuelson,[1] a public good[2] has the attribute "that each individual's consumption of such a good leads to no subtraction from any other individual's consumption of that good...."[3]

Where the consumption of private goods requires as many units to be produced as are demanded by all consumers combined, the same amount of a public good that is produced is simultaneously available for consumption by all consumers. Thus, the use by one individual of a recorded song, or computer program, or journal article, does not diminish the availability of that good for use by others. This characteristic of public goods is variously characterized as joint, or non-rival, consumption.[4] A corollary of the fact that all consumers can use the same public good without diminishing the amount available for others is that the cost per user declines as the number of users increases.

Public goods often, though not always, possess a second characteristic that distinguishes them from private goods. It is often difficult, or prohibitively expensive, to exclude those who do not pay to use public goods from the benefits that the goods provide to them. Thus, if a public good is national defense, or a fireworks display, it may be impossible to prevent "free riders," those who choose not to pay for access to the good, from benefitting from its existence. Indeed, if the public good is knowledge, the exclusion problem may be even more severe, since one may have to reveal to potential buyers the nature of the good in order to get them to purchase it. However, they may have no need to purchase it once it has been revealed to them.[5] This characteristic of public goods is often called non-exclusion.

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[1] P.A. Samuelson, "The Pure Theory of Public Expenditure," 36 *Review of Economics and Statistics* 387 (1954).

[2] Actually, Samuelson uses the term "collective consumption good," but public good is the now commonly-accepted terminology.

[3] Id. at 387.

[4] We are clearly distinguishing here between the physical embodiment of the intellectual property, the tape or phonograph record, the computer diskette, or the printed journal, and its contents. Only the latter is a public good.

[5] K. J. Arrow, "Economic Welfare and the Allocation of Resources for Invention," in National Bureau of Economic Research, *The Rate and*

These two characteristics of public goods, jointness in consumption and the difficulty, or impossibility, of exclusion, make it unlikely that markets for public goods, such as intellectual property, will function as efficiently as do markets for private goods. The efficient production of private goods requires that they be produced to the point where the value that consumers place on the "last" unit equals the additional cost of producing it, its marginal cost. If private goods are produced in competitive markets, and if there are no externalities in their production, i.e., if producers bear all costs that result when the goods are produced and consumers reap all of the benefits, the efficient amounts will be produced. Moreover, the prices of these goods will be equal to their marginal costs.[6]

The condition required for the efficient production of public goods is much more complex and less likely to be fulfilled.[7] Essentially, efficiency requires that public goods be produced to the point where the value that all consumers *combined* place on the last unit produced equals

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Direction of Inventive Activity: Economic and Social Factors, Princeton: Princeton University Press, 1962 at 615 argues that "there is a fundamental paradox in the determination of demand for information; its value for the purchaser is not known until he has the information, but then he has in effect acquired it without cost."

[6] The allocation of resources is efficient when it is impossible to increase the value of the goods being produced by reallocating resources among them. The marginal cost of a good is the cost of acquiring the resources needed to produce an additional unit, which, in turn, equals the value of the outputs of other goods whose production must be concomitantly reduced. When the value of a good equals its marginal cost, the efficient amount is being produced, since the value of additional output is less than the value of the associated reduction in the output of other goods. Similarly, if a smaller amount is produced, the lost output will have a higher value than the increased production of other goods. Only where the value of output equals marginal cost is efficiency achieved.

Note that achieving economic efficiency is not necessarily synonymous with maximizing the returns to producers. In the calculus involved, the interests of both consumers and producers count. Indeed, the basis for promoting the interests of producers is that it is instrumental in promoting the interests of consumers.

[7] In some instances, public policy may be concerned with fostering objectives other than economic efficiency, e.g., by promoting the widespread availability of certain types of intellectual property. In such cases, the efficiency standard provides a benchmark against which to measure the costs of pursuing such policies.

its marginal cost. Each consumer can choose to consume different amounts of private goods, and thus can adjust his consumption so that the last unit purchased of each good is valued at its market price. In contrast, since the amount of a public good potentially available is the same to all consumers, the values that each consumer places on the last unit produced will vary among them. Producing the last unit is efficient only if the combined value placed on that unit by all consumers at least equals the cost of producing it. The condition for efficiency that prevails for private goods, that the value of a good is equal to its marginal cost, is thus replaced for public goods by the condition that the sum of the values of a good for all consumers is equal to its marginal cost.[8]

If all consumers are charged the same price for the public good, consumers who value the good at less than the price will be unwilling to purchase it.[9] This is inefficient since, by definition, there are no additional costs to serving these consumers. At the same time, consumers who value the last unit produced at more than the market price contribute less to the production of the public good than its value to them. Efficiency thus requires that different consumers be charged different prices for the same public good.

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[8] Generally, the value placed on a unit of a good by one consumer is assumed to be independent of the number of others who purchase it. However, the value of some goods may be affected by the number of other purchasers. Thus, for example, the value of subscribing to a telephone system increases the larger is the number of other subscribers, since this increases the number of others who can be called or from whom calls can be received. Similarly, the value of a computer may increase as the number of purchasers of compatible computers increases, since this may result in a greater variety of software from which to choose. The value of a particular print will be reduced as the number of other prints made from the same master is increased, if value inheres in possessing one of a small number that have been produced. And the value of certain types of information may be more valuable to any consumer the smaller is the number of other consumers with whom it is shared. For a sampling of the literature on interdependent demand see H. Leibenstein, "Bandwagon, Snob, and Veblen Effects in the Theory of Consumers' Demand," 64 *Quarterly Journal of Economics* 183 (1950); J. Rohlfs, "A Theory of Interdependent Demand for a Communications Service," 5 *Bell Journal of Economics and Management Science* 16 (1974); and M.L. Katz and C. Shapiro, "Network Externalities, Competition, and Compatibility," *American Economic Review*, forthcoming.

[9] We are assuming here that exclusion is possible.

Although efficiency requires producers of public goods to set prices for different consumers to reflect differences in their values of the goods, producers are unlikely to have the information required to establish prices in this manner. And, of course, individual consumers will wish to misrepresent the value of public goods to them, in order to obtain lower prices.[10] If a uniform price is established for all consumers, the revenues of producers will be less than if consumers paid the value that they place on the last unit. As a result, it is unlikely that the efficient amounts of public goods will be produced.

If exclusion is possible, the private production of public goods, intellectual property for example, is possible, although, as we have argued, production will generally not be efficient. Where there are many producers of competing types of intellectual property, for example competing producers of phonograph records or word processing software, the resulting market structure is one of monopolistic competition.[11]

The industry producing the public good will be characterized by a number of firms, each of which has some control over the price it charges, and all of which earn only normal profits in the long-run. Each firm has some control over its price, because the various public goods are assumed to be somewhat differentiated. A firm can charge a price that exceeds that of its rivals without losing all of its customers because some consumers especially value the particular characteristics of its product.[12] In the long-run, only normal profits are earned because supranormal profits attract entry by new firms, or the provision of new products by existing firms. This reduces the demand for existing products, and entry continues until only normal profits are earned by incumbent firms.[13]

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[10] Such a strategy is especially likely where the number of consumers is large, since any individual's contribution will not have a significant effect on the amount of the public good produced.

[11] See E.H. Chamberlin, *The Theory of Monopolistic Competition*, Cambridge: Harvard University Press, 1934.

[12] Of course, even they may shift their purchases if the price differential is large enough.

[13] In some markets for intellectual property, producers may continue to earn supranormal profits even in the long run. This occurs where barriers to entry prevent new producers from entering the market, attracting customers from incumbent firms, driving down prices, and

There are two important characteristics of the long-run equilibrium of such an industry. First, for the reasons discussed above, the equilibrium is unlikely to be efficient. Second, there may be either "too little" or "too much" variety in the products that are offered. Excessive variety may result because, although firms will find entry profitable if they can attract enough consumers from other producers to cover their costs, since the products are public goods, the reduction in the number of consumers served by existing firms does not produce a commensurate reduction in their costs. Entry may, thus, prove to be profitable even if the cost incurred by the entrant exceed the value that consumers place on the additional variety.[14]

It is also possible, however, that the equilibrium will be characterized by too little product variety. This will occur if firms find it more profitable to "duplicate" the products of their rivals, rather than offer differentiated products. If the profitable provision of highly differentiated products can occur only where different prices can be charged to different consumers of the same product, while undifferentiated products can be sold profitably at a single price, the differentiated products will not be offered even if efficiency would be increased by doing so.[15]

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eliminating excess returns. This situation probably characterizes the market for broadcast television, where FCC restrictions have limited the number of stations that can be licensed in a community, although recent changes, e.g., the deregulation of cable television, probably have reduced the market power of broadcasters and their ability to earn supranormal profits in the long run. Individual newspaper markets are increasingly characterized by monopoly operations, which probably result from the existence of economies of scale, although the market power of newspapers and their ability to earn supranormal profits are constrained by the existence of limited circulation newspapers, national magazines, and radio and television stations. On concentration in broadcast television see R.W. Crandall, "Regulation of Television Broadcasting: How Costly Is the 'Public Interest'?," 2 *Regulation* 31 (1978) and on concentration in newspapers see J.N. Rosse and J. Dertouzos, "Economic Issues in Mass Communications Industries," in Federal Trade Commission, *Proceedings of the Symposium on Media Concentration, Volume I*, 1978, at 72-81.

[14] The inability to charge different prices to different consumers produces this result. If defecting consumers could be offered a lower price in order to encourage them not to choose the new product, other consumers might be better off, even if they must pay a higher price than the would-be defectors.

[15] For two analyses of the provision of public goods in competitive

The problem caused by the inability of producers to charge different prices to different consumers is exacerbated when it is impossible, or prohibitively expensive, to exclude non-payers. Where exclusion is not possible, individual consumers can rationally be expected not to make payments for the use of the public good, since they have access to the good whether they pay for it or not.[16]

In the case of intellectual property, the patent and copyright systems are designed to deny to those who do not make payments the use of the fruits of intellectual effort. However, even when intellectual property is protected in this way, exclusion may still be difficult. For example, preventing private copying or off-air taping is likely to be difficult, even if the law grants creators the right to control such uses.

To the extent that owners of intellectual property are unable to exclude non-payers, their revenues will decline and their willingness and ability to produce new types of intellectual property will diminish.[17] What the effect of this reduction will be on the efficiency of the supply of intellectual property will be is a difficult question that depends, in turn, on the answers to two other questions: First, by how much will the supply of intellectual effort be reduced when the return to such effort is reduced? What, in other words, is the elasticity of supply of intellectual property? Second, given any reduction in the amount of intellectual property produced, what effect will there be on economic efficiency?

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markets see H. Demsetz, "The Private Production of Public Goods," 13 *Journal of Law and Economics* 292 (1970) and W.H. Oakland, "Public Goods, Perfect Competition, and Underproduction," 82 *Journal of Political Economy* 927 (1974). In both models, the products sold by competing firms are perfect substitutes. In the Demsetz model, the production of public goods by competitive firms is efficient, because Demsetz assumes that different consumers of the same good can be charged different prices. Production is inefficient in the Oakland model where the same price is charged to all purchasers from the same firm.

[16] Once again, the validity of this statement is enhanced if the number of consumers is large.

[17] The next section deals with methods of finance that suppliers of intellectual property may adopt as alternatives to direct sales to consumers.

Assessing the elasticity of supply of intellectual property is a difficult, if not impossible, undertaking. The basic reason for this lies in the differentiated nature of the products involved. If we were trying to estimate the elasticity of supply of a standardized product, say West Texas intermediate crude oil, we could gather market data on its price, the quantity exchanged during any period, and the variety of factors thought to influence the supply and demand for oil. With this information, estimating the demand and supply functions is a feasible undertaking.[18] Given the supply function, one can estimate the effect of a reduction in the amount that consumers will pay for oil on the amount that is offered on the market and on its price.

Where the good in question is not homogeneous, however, it is far more difficult to estimate the supply function, since a change in the amount paid to producers will affect both the *quantity* and *nature* of what is produced. As a result, determining the effect of a shift in demand on the quantity supplied and its price is a difficult undertaking. Thus, for example, unless one is prepared to treat all word processing programs as perfect substitutes, one cannot easily characterize the effect of a reduction in the return to software suppliers on the amount of such programs that are produced and sold.[19]

There may be no change in the number of programs available, but a reduction in the quality of each. Or, the number of programs may decline, with the smaller number being worse than, as good as, or even better than, the larger number that they replace.[20] Or, there may even be an increase in the number being offered, with the each being of lower quality than the larger number originally offered.

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[18] See L.R. Klein, *An Introduction to Econometrics*, Englewood Cliffs: Prentice-Hall, 1962, at 8-19 for an elementary exposition. For a more advanced treatment see J. Kmenta, *Elements of Econometrics*, New York: Macmillan, 1971, at 539-550. Even where the product in question is homogeneous, estimation of the supply function may be a formidable task.

[19] We are assuming that exclusion is not so difficult as to prevent production entirely. If the costs of exclusion are independent of the number of customers, only firms with a large customer base may find it profitable to incur such costs.

[20] The smaller number may or may not be among the larger.

To determine the effect on supply of a change in the rewards to producers, one begins by obtaining data on the number of units of a given type of product, say, word processors, that were sold in various periods, as well as on the prices paid to suppliers in those periods.[21] Since output is not homogenous, one must adjust the data in order to control for differences in "quality." Doing so permits both the aggregation of different products sold during the same period as well as comparisons among the amounts of all products that are sold during different periods.

If one knows the values that consumers place on the different characteristics of, say, word processors, e.g., speed, ease of use, capacity, in principle the necessary quality adjustment can be made. First, the prices of the various packages in some base period are statistically related to their characteristics in order to determine the values placed by consumers on each of the various attributes.[22] These values, and the characteristics of each package sold in each period, are then used to weight the output of each package in each period and the quantities of each package sold, adjusted for "quality," are added together for each period. The resulting totals reflect changes over time in both in the number of packages sold and their characteristics. To the extent that improvements in quality occur, the quantities are adjusted upward to reflect that fact. Thus, a two-fold improvement in each characteristic results in a doubling of measured output, if there is no change in the number of packages sold. Finally, the market "price" is obtained by dividing total revenues from the sale of all packages by quality-adjusted output.

Adjusting quantity data to account for differences in quality may be a feasible undertaking where the characteristics of a good are easily identifiable and are changing slowly.[23] Where changes are rapid, so that new characteristics are continually being made available, and are occurring in combinations previously uncontemplated, the task is a formidable one, indeed. In order to carry out the quality adjustment, it is necessary to place a value on each of the characteristics. But how, for example, is one to determine, using price data from an earlier period, the value that consumers place on having a word processor, a spread sheet, and a database manager combined in the same software package? In addition, one has the problem of determining how to define the class of products being considered. Should it, for example, be all applications programs or should there be separate analyses for spread sheets, word processors, and data base managers?

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[21] These data often are not publicly available.

[22] Z. Griliches, "Hedonic Price Indexes for Automobiles: An Econometric Analysis of Quality Change," in *The Price Statistics of the Federal Government*, New York: National Bureau of Economic Research, 1961, at 137-196, carries out such an analysis for automobiles.

[23] Even there, however, it is likely to be difficult.

Constructing a consistent set of data on quality-adjusted output and price is, of course, only the first step in the process of estimating the elasticity of supply. The analysis also requires the ability to control for factors other than price that affect supply. That is, changes in prices and their associated changes in output suffice to identify the supply curve only if it can be assumed that the function relating quantity supplied to price is unchanging. If, however, there are factors other than price that affect supply, these must be taken into account. Thus, for example, advances in microelectronics may affect the cost of providing a given capability in a computer program, which, in turn, will affect the supply of (quality-adjusted) output. Clearly, where technology is changing rapidly, it will be difficult to control for the effects of these other factors.

As we have already argued, even where exclusion is possible, there may be too much variety in the range of intellectual property produced. One implication of this result is that, even if the inability to exclude non-payers *reduces* the *amount* of intellectual property supplied, the result may be to *increase* the *efficiency* of supply, by bringing variety closer to the optimum. Instead of a relatively large variety of imperfect substitutes being produced, each at a relatively high cost (and price) per user, the reduction in the returns to producers may result in fewer producers each serving a larger number of consumers, at a lower cost per consumer.[24] The result is that consumers may actually be better off.

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[24] In both situations, of course, the firms that survive earn only

Of course, the reduction in the returns to producers that results from their inability to exclude non-payers may make consumers worse off. This occurs if the additional variety that is lost when some producers leave the industry is valued by consumers at more than its additional cost. As we have already seen, there will be circumstances in which consumers may prefer a wide variety of products, although each must be produced at a higher cost per user than if a narrower variety were available. In such circumstances, if non-payers cannot be excluded, the result is to reduce the efficiency of supply.

The contention that an increase in the return to producers of intellectual property will necessarily lead to an increase in the the efficiency of its supply has also been challenged on other grounds. Plant, in two articles[25] highly critical of the copyright and patent systems, argues that patent and copyright protection may actually reduce economic efficiency. Plant contends that the existence of private property rights in intellectual property may have only a limited effect in encouraging the *creation* of new ideas and that, by limiting the competition to which producers are subject, it raises the prices of goods embodying intellectual property, leading to the inefficient *use* of such ideas. He argues that unless the gains from additional creation more than offset the inefficiencies from reduced use, the copyright and patent systems cannnot be justified. As Plant puts it: "The only conceivable line for such an argument to take would seem to be that ultimately the inventions of a patentable type which will be made in response to the grant of a temporary monopoly will possess a sufficiently greater usefulness than would result from the other inventions or other output immediately foregone, to outweigh the immediate loss. There surely exists no scientific reason for making any such claim for patentable inventions in general, as compared with alternative output."[26]

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normal returns. This results from by the assumption that there is free entry.

[25] A. Plant, "The Economic Aspects of Copyright in Books," 1 *Economica* 167 (1934) N.S. and "The Economic Theory Concerning Patents for Inventions," 1 *Economica* 30 (1934) N.S.

[26] "The Economic Theory Concerning Patents for Inventions" at 42-43.

Of course, for copyrighted material to be published, the publisher must be able to obtain revenues at least equal to the cost of producing the "first copy," as well as the cost of additional copies that are produced. Thus, even if a manuscript is provided without cost to the publisher, say because the author has non-pecuniary objectives in getting it published, the publisher must incur the costs of editing, typesetting, proofreading, etc., as well as the costs of printing. The question then arises as to how, in the absence of copyright protection, revenues sufficient to cover these costs will be obtained, since presumably a second publisher could avoid many of the costs incurred by the first publisher. Nonetheless, Plant argues that publication would occur, and that it did occur in nineteenth century America, even in the absence of copyright protection.

Breyer argues[27] that the first publisher has a number of advantages that inhere in being first, that make profitable publication possible even in the absence of copyright. First, he argues that the initial publisher's book will reach the market first, thus creating a marketing advantage over publishers who enter the market later. Presumably, the argument is that the first publisher will be able to make sales during the period before it must face competition from a second publisher's book. Since consumers can be expected to anticipate the second publisher's entry into the market, the advantage that results from entering first is primarily the result of the fact that some consumers value early access.

Second, Breyer argues, following Plant, that a second entrant may be discouraged by the fear that, if he enters, the initial publisher will reduce price below the cost of the entrant, thus rendering entry unprofitable. Whether this will be a rational strategy for the incumbent firm to pursue, and how it might go about pursuing it, can be assessed in the context of the modern literature on "strategic entry deterrence."[28] A first entrant, fearing the possible arrival of a second firm, can arrange to print more copies than it anticipates selling at the price it plans to establish. Although this involves incurring additional costs, the presence of these additional copies serves to discourage the second entrant if a rational, i.e., profit maximizing, response to entry is to place the additional books on the market.[29] If the strategy is rational, and if the second entrant recognizes it as such, entry may be discouraged, since placing the additional supply on the market will reduce the market price. The additional copies play the same role as does the excess productive capacity analyzed by Spence.[30]

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[27] S. Breyer, "The Uneasy Case for Copyright: A Study of Copyright in Books, Photocopies and Computer Programs," 84 *Harvard Law Review* 281 (1970)

[28] See S.C. Salop, "Strategic Entry Deterrence," 69 *American Economic Review Papers and Proceedings* 335 (1979) for a brief introduction.

It should be noted that, although this approach may permit the first publisher to operate profitably, it still permits the exercise of market power. Indeed, since real resources must be expended to print the "excess" copies, the outcome may be less efficient that if a copyright were granted in the first place.[31] Breyer appears to approve the adoption of strategies by the first entrant that discourage entry, and thus create market power, yet he rejects copyright because it leads to market power.

Third, Breyer argues that the initial publisher may be able to operate profitably if it can obtain a large number of orders in advance of publication. Although this is surely correct, the question arises as to why customers will wish to enter such orders if they anticipate that lower cost copies will be placed on the market shortly after the initial publication. Any individual customer has an incentive to "free ride" on the behavior of others by not placing an early order. But if all customers attempt to free ride, this strategy will not be successful.[32]

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[29] An essential element of an entry deterring strategy is that the incumbent commits itself to an irreversible investment. The printing of the additinal copies is such an investment. Merely threatening to reduce price, or to print additional copies, if entry occurs may not be an effective strategy if the potential entrant realizes that pursuing the strategy is not profitable for the incumbent.

[30] A.M. Spence, "Entry, capacity, investment and oligopolistic pricing, 8 *Bell Journal of Economics* 534 (1977).

[31] This is because the copyright deters entry but does not consume resources as does the "excess production" strategy. There are, of course, costs involved in obtaining and enforcing the copyright.

[32] Of course, the initial publisher can offer to sell at a low price to those customers who pre-commit, but then the return to publishing is reduced, and some books may not be published.

What the Plant-Breyer arguments come down to is a belief that the balance between encouraging creative effort and promoting widespread distribution of intellectual property may be struck more efficiently for some types of goods without a copyright system. They believe that, although encouraging the creation of intellectual property may require that publishers have some market power, the extent of market power created by copyright may, at times, be excessive. In those cases, they argue, allowing publishers to obtain market power through their own efforts may result in a more efficient allocation of resources than that produced under the copyright system.[13]

The appropriate legal treatment of intellectual property for promoting economic efficiency is almost certainly somewhere between the Plant-Breyer view, that no protection is needed, and the other extreme, in which all rights in property should be granted to creators for all time. The question is, thus, not whether to grant patent or copyright protection, but rather what is the appropriate period of protection and what rights should be covered.[14] The "correct" answer is likely to differ among types of intellectual property.

2. ECONOMIC BEHAVIOR OF PRODUCERS OF INTELLECTUAL PROPERTY

The special characteristics of intellectual property--jointness in consumption and the difficulty of exclusion--have resulted in the adoption by producers of a variety of ways of marketing their products. Producers do not confine themselves to selling individual units of their products directly to final consumers. Instead, they may employ advertiser support, or they may attempt to bundle the intellectual property with private goods, in order to enhance their ability to exclude non-payers. In addition, it is common for producers to attempt to exploit their products over extended periods of time and in different markets. Finally, a substantial portion of the supply of intellectual property is supported by grants from governments or non-profit institutions. This section discusses the factors that affect the choice of marketing approaches that producers must make.

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[13] The argument seems not to have been characterized in this way, but this interpretation is consistent with Plant's contention that, in 19th century America, "competition remained sufficiently removed from that abstract condition of 'perfection,' in which there could exist no margin between receipts and costs for the remuneration of authors, for 'handsome sums' in fact to be paid." "The Economic Aspects of Copyright in Books," at 172-173.

[14] For an interesting attempt to determine the "optimal" life of a patent see W.D. Nordhaus, *Invention, Growth, and Welfare, A Theoretical Treatment of Technological Change*, Cambridge, MA: The M.I.T. Press, 1969, at 76-86.

a. Advertiser Support

In principle, even the production of private goods could be supported through the sale of advertising. A pair of shoes, for example, could be packaged together with advertising material, with the advertiser paying all or a part of the cost of making the shoes in return for the opportunity to have his advertising reach the shoe buyer. If this method of support were employed, the price of shoes would be lower than if consumers were required to pay for them. Moreover, those types of shoes would be produced that advertisers found most effective in reaching consumers.

Of course, advertiser support for the production of private goods is rare, or non-existent. Rather, advertiser support seems confined entirely to a class of public goods -- printed matter and audio-visual material -- and not even to all members of this class. For example, although newspapers and mass audience magazines are supported in large measure by advertising (with substantial support directly from subscribers in some cases),[15] publications such as professional journals are supported almost entirely from subscription revenues. And, although advertising now constitutes a large portion of the support for certain types of entertainment programming on television, series and sports, motion picture production is supported in large measure by direct sales to moviegoers.[16] "Made-for-television" motion pictures are an obvious exception.

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[15] Advertising revenues constitute about three-quarters of the revenues of newspapers. Among magazines, they represent about 80% of the revenues of farm periodicals, about 70% of the revenues of business and professional periodicals, and less than half of the revenues of general periodicals. See C.H. Sterling and T.R. Haight, *The Mass Media: Aspen Guide to Communication Industry Trends*, New York: Praeger, 1978, at 158, 174.

[16] The sale of motion pictures to advertiser-supported television

There appear to be three principal bases for determining which types of intellectual property are supported by advertising. First, the fact that radio and television have traditionally been supported in this way probably results from the fact that, until recently, no other method of finance was feasible. Early radio stations did not possess the technical means to exclude non-paying listeners. An enterprising station owner decided to experiment with advertising in order to see whether revenues might be generated in this manner. The result was far more successful than anyone had anticipated, and advertising remains today the principal basis on which commercial radio and television stations are supported. Where exclusion of non-payers is a problem, advertising may be an effective alternative means of support.[37]

More recently, however, technological developments have occurred that have permitted television programs to be made available only to those viewers who subscribe to a particular service. Almost all subscription services provide all of the programming on a particular channel in return for a monthly fee.[38] On rare occasions, subscription programming is provided on a per-program basis, but the cost of excluding non-payers still is sufficiently great that only when the fees that can be collected for an individual program are very high can these exclusion costs be justified. In the future, it is reasonable to expect that pay per-view will become more widespread, as technological change reduces the costs of exclusion.[39] As a result, advertiser support is

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was a more important source of support prior to the widespread availability of pay-television over cable. Motion picture studios today delay the sale of films to advertiser-supported television until the end of the pay "window." As a result, both the networks and individual broadcast stations are willing to pay less for such films, because many viewers will already have seen them on cable.

[37] Since exclusion is generally not a problem for private goods, we generally do not observe their production supported in this way.

[38] For descriptions of the various industries now supplying pay television services see Y. Braunstein, *Recent Trends in Cable Television Related to the Prospects for New Television Networks*; K.B. Glen, *Subscription Television*; and K.B. Glen, *Multi-Point Distribution Service*; all prepared for the Federal Communications Commission, Network Inquiry Special Staff, 1980.

[39] See "Pay-Per-View TV Is Gaining Subscribers as Fixed-Schedule Cable Loses Favor," *Wall Street Journal* (January 10, 1985) at 29 for a discussion of these developments.

likely to become proportionally less important for the support of television.

Advertiser support has also been employed when there were restrictions on other means of support. When pay-television was first proposed in the 1960's, in response to complaints from theater owners and broadcasters, the Federal Communications Commission erected a series of barriers to the provision of pay-television that effectively stifled the industry until the Home Box Office decision in 1977.[40] Restrictions were placed on the amount and nature of the programming that could be provided,[41] on the portion of the program schedule that could be devoted to pay television transmissions, and on the licensing of stations to provide pay programming.[42] These rules are now all abolished, but when they were in effect they significantly constrained the ability of of producers of certain types of intellectual property to use means of financing other than advertising. For example, a rule that prevented television series programming from being carried on a pay basis meant that such programming had to be supported by advertising, if it was to be provided at all.

Finally, advertisers can be expected to seek to employ those media that are most effective in promoting their wares. Thus, for example, newspapers can obtain revenues from subscriber sales, and have never been restricted from doing so, yet, because they are an effective advertising medium, they continue to rely heavily on advertiser support. The same is true for certain types of magazines. So long as advertisers need to advertise, they can be expected to support these creative activities that assist them in doing so.[43]

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[40] Home Box Office, Inc. v. FCC, 567 F.2d 9 (1977); Cert. den. 434 U.S. 829 (1978).

[41] 15 FCC 2d 466 (1968); 34 FCC 2d 271 (1972); 52 FCC 2d 1 (1975).

[42] The "complement of four" rule, which prevented the licensing of a pay television station unless there were at least four advertiser-supported stations in a market, was repealed in 90 FCC 2d 341(1982).

[43] In principle, advertisers could limit themselves to "advertising-only" vehicles, e.g. billboards, fliers. However, the long history of support for magazines and newspapers in the absence of any legal restriction suggests that this is unlikely to occur. Moreover, even in the absence of legal restrictions on the provision of programs on a subscription basis, television is likely to continue to be a major receipient of advertising revenues.

Many of the media that are effective as advertising vehicles--radio, television, newspapers, and magazines--seem to have a common characteristic. All of them appear frequently, some more or less continuously, others daily or weekly. Thus, advertising of new products, or new prices for old products, or the repetitive advertising of products, is possible using these media. These same ends cannot be accomplished through those media that appear less frequently.[44] If the same newspaper could be employed over and over again it would not be such an attractive vehicle for certain types of advertisers. For the same reason, we would not expect computer programs to be supported by advertising, since consumers are likely to use the same program many times over a long period of time. Nor would we expect pre-recorded audio or video records or tapes to be employed in this manner. However, if these products are rented for a single use, rather than purchased to be used many times, advertising might be feasible as a means of support.[45]

b. 'Bundling' with Private Goods

One way in which producers of intellectual property can be expected to attempt to overcome the, exclusion, or "free rider" problem is by combining the sale of the public good with the sale of a private good for which exclusion is feasible.[46] A modern example involves the provision of user services of computer programs only to authorized purchasers. If these services are especially valuable, and if possessors of unauthorized copies cannot obtain them, consumers can be expected to purchase originals directly from the producer even if copying were easy and undetectable. Another example is the provision of detailed program guides by some public television stations to encourage contributions by viewers who cannot be excluded even if they do not pay.

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[44] Other media may, however, also have unique advantages for certain types of advertising. The ubiquitous nature of telephone directories makes Yellow Page advertising desirable, even though these publications are updated only once a year. In the future, "electronic Yellow Pages" may permit this medium to compete even more effectively with newspapers for certain types of advertising. For this reason, newspaper publishers have sought to limit the ability of telephone companies to provide this service. However, it could be provided by lessees of telephone facilities, including the newspapers themselves. For a discussion of the economics of electronic Yellow Pages, see I. de S. Pool, *Technologies of Freedom*, Cambridge, MA: Harvard University Press, 1983, at 206-209.

[45] If videogames were downloaded to personal computers only as used, advertising might be a feasible source of support, especially if it is easy to change advertising messages.

[46] For a general discussion of this approach see M. Olson, *The Logic of Collective Action*, New York: Schocken Books, 1968, Chapter VI. Olson, at 134, argues that, in the absence of coercion to join a group

Under the bundling strategy, the firm sells the bundle at a price that exceeds the cost of producing the private good. The difference is used to support the production of the public good. Thus, the success of the strategy hinges on the ability to price the bundle at a level that generates sufficient revenues to support the production of both goods.

The feasibility of bundling public with private goods in order to encourage the provision of the former will, of course, vary among products. In order for the strategy to be successful, the firm providing the public good must have an advantage in providing the bundled private good. If the private good can be provided as efficiently by firms other than the provider of the public good, consumers can be expected to avoid purchasing the bundle, and the strategy will be defeated.[47] If a rival program guide can be produced at the same cost as can the one provided by the television station, it will garner the entire market if the station attempts to charge more than the cost of its production.

There must, of course, be some complementarity between the elements of the bundle for consumers. Otherwise, a producer with a cost advantage in producing the private good would earn larger profits if it chose *not* to provide the public good. However, if the private good has value only if the public good is also provided, the firm will be forced to offer both.[48] The seller would have no objection, however, to

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that provides a public good, an individual will join only if "he has to support this group in order to obtain some other noncollective benefit." He calls this the "by-product" theory.

[47] The economics are similar to those involved in the controversy over resale price maintenance. Full service stores may have difficulty surviving if they incur the cost of providing information, a public good, to shoppers who, in turn, purchase the good at a lower price from discounters, who do not provide information. See "'Round and 'Round on RPM", *Regulation*, January/February 1984 at 19-32.

[48] That is, a television station cannot only offer program guides.

offering the private good to those who do not wish to consume the public good. Thus, collectors of program guides would not be prevented from purchasing them, even if they never watched the station.

c. Direct Sales to Consumers

Despite the difficulties of excluding non-payers and of charging different prices for the same public good to different consumers, the production of many public goods, including intellectual property, is financed largely, or entirely, through direct sales to consumers. Thus, recorded songs, computer programs, and professional journals are sold directly to consumers, unbundled with any other products.[49] Or, in other words, although excluding non-payers is difficult, there are instances in which individual consumers prefer to purchase their own unit of the good rather than to share with other consumers. And, indeed, this can occur even when it is impossible for the producer of the good to prevent such sharing.

Sharing can occur in two ways. The use can be sequential, as when magazines or books are passed on to other readers after they are read, or when pre-recorded videocassetes are rented to a succession of viewers. Or the good can be used simultaneously by various users, as when computer programs are reproduced, or books or articles are photocopied, or when a fireworks display that is paid for by one set of consumers is viewed by those who do not pay to do so.

What are the characteristics of those types of intellectual property for which direct user purchases, although not necessarily optimal, are at least a feasible source of support? First, direct user purchases are more likely the lower is the price of the good, other things equal. Thus, for example, we do not observe as much sharing of daily newspapers as we do of professional journals, since the price of the former is so low that most consumers prefer to purchase their own original. By contrast, sharing of expensive computer programs is apparently the rule rather than the exception.

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[49] Some computer programs are sold bundled with "hardware," but the typical manner in which they are sold is as described in the text.

Second, other things equal, if the costs of forming a sharing group are high, the purchase of originals will be encouraged and direct user finance will be feasible. One suspects that sharing of special purpose computer programs is less prevalent than is the sharing of general purpose word processors or spreadsheets, since identifying others with whom to share is more costly in the former case.

Third, other things equal, sharing is less likely the more easily can the producer prevent sharing. If it were inexpensive to exclude non-payers from viewing a fireworks display, private support for such displays would be more prevalent than it is today. In the case of intellectual property, where sharing is a copyright infringement and where the cost of detecting and prosecuting infringments is low, direct consumer support is more likely. By contrast, if sharing is "fair use," or if enforcing copyrights is difficult, it is more likely that an alternative to direct user financing will have to be employed if the intellectual property is to be produced.

Fourth, other things equal, direct user support is more likely the easier it is for producers to charge different prices to different users, based on differences in their "willingness to pay."[50] Moreover, for some goods, profitable operation will be possible only if price discrimination is practiced.

One set of suppliers of intellectual property that engages in price discrimination is publishers of academic journals, who are able to charge higher prices for institutional than for individual subscriptions.[51] Similarly, the publication of both hardback and paperback editions of some books permits higher prices to those who require early access than to those who are willing to wait. However, because of the "first sale" doctrine, producers of pre-recorded videocassettes cannot charge different prices to individual consumers and the proprietors of video rental stores.

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[50] Technically, price discrimination involves setting prices higher the lower is the elasticity of demand. See, e.g., J.M. Henderson and R.E. Quandt, *Microeconomic Theory*. New York: McGraw-Hill, 1958, at 170-172.

[51] See E.A. Dyl, "A Note on Price Discrimination by Academic Journals," 53 *Library Quarterly* 161 (1983) for a discussion of the extent of this practice by journals in economics and business.

Finally, direct user support is more likely if producers can adjust the prices of those units that are sold directly to consumers to reflect the existence of sharing. In other words, to the extent that producers can raise their prices to reflect the fact that their products are being employed by more than a single user, they may be able to obtain enough revenues to be financially viable. Indeed, there may be circumstances in which sharing actually benefits producers, or at least does not reduce their profits.[52] However, even where prices can be increased to reflect sharing, producer profits may fall if the cost of adding an additional user of an original exceeds the additional cost of producing an original.

Of course, the viability of the strategy of increasing prices to reflect sharing depends on the ability of consumers to prevent non-payers from using the public good. In other words, the success of the strategy is based upon a greater ability on the part of consumers than of producers to prevent free-riding. Thus, although it may be impossible for a computer software vendor to prevent the sharing of his programs through copying, if those groups that form to share the programs are able to police their members to prevent them from giving copies to non-members, this strategy may be effective. If, however, exclusion is no easier for consumers than for producers, a strategy of raising prices will not work, since the first purchaser cannot recoup the high price paid to the producer by obtaining payments from all of those who share his original. This suggests that the strategy will be most effective when the size of the sharing group is relatively small, or where all sharers are under common diretion, e.g., they all are employed by the same firm. On the other hand, where the sharing groups become very large, preventing a member from sharing his copy with non-members becomes very difficult, so that the exclusion problem for the group is no different from that of the producer itself.

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[52] S.M. Besen, *Private Copying, Reproduction Costs, and the Supply of Intellectual Property*, Rand Corporation N-2207-NSF, December 1984, develops a model in which sharing can increase, leave unchanged, or reduce the profits of producers of intellectual property. A necessary condition for sharing to increase profits is that, for some users, the incremental cost of producing and distributing originals exceeds the incremental cost of producing and distributing copies.

One other significant characteristic of the sale of intellectual property must also be mentioned here. For certain types of property, exploitation by the seller occurs over an extended period of time and in a variety of different markets. Thus, a novel may be serialized in a magazine, printed in hardback form, sold as a paperback, and adapted into a motion picture. Similarly, a motion picture may be shown in theaters, sold in videocassette form, distributed over pay-television, carried on one of the networks, and syndicated to individual television stations. Some stages of the process may even be repeated, as when "classic" films that have already appeared on network television and in syndication are shown in theaters or on pay-television.

This method of exploitation has two significant elements. First, by permitting the producer to draw upon a number of different sources of revenue, he can be expected to be willing to invest more in development than if his revenues were limited to a single initial market. Second, this approach may allow producers to engage in some form of price discrimination, which, as we have argued earlier, is required for efficient production. Thus, for example, the existence of a paperback market permits, to some degree, charging higher prices to those customers who place a higher value on a book than do others.[53]

If the market for intellectual property is (monopolistically) competitive, the combined revenues from all sources will just cover the costs of producing the property, including a normal return on invested capital. The inability to exploit an existing market can be expected to cause some suppliers to leave the industry and others to reduce the number or quality of the properties that they offer. A similar effect will be felt to the extent that a new market cannot be exploited.[54]

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[53] This is not to suggest that price discrimination can easily be accomplised of that the resulting prices are necessarily the efficient ones.

[54] Note that this does not mean that suppliers will incur losses. To the extent that production decisions correctly anticipate which markets can be exploited, the sole effect of foreclosing a market is to reduce the amount of intellectual property produced. Only where production decisions are based on incorrect assumptions about the markets available to producers will losses result.

There are many examples of limitations on the ability of producers of intellectual property to exploit additional markets. The FCC restrictions on pay-television limited revenues for motion picture production to those from theatrical distribution and advertiser-supported television. The "first sale" doctrine limits the ability of motion picture companies to exploit the video rental market. To the extent that other countries do not respect United States copyrights, revenues from those markets are denied to copyright owners. When cable television systems were not liable for copyright infringements when they retransmitted broadcast signals, television program producers were denied access to that market, and even now there is some question of whether the compulsory license fees paid by cable systems reflect the prices that would otherwise have prevailed in the marketplace.

d. Support by Government or Non-Profit Institutions

A substantial amount of the development of intellectual property is supported directly by government or non-profit institutions. Indeed, it has been argued that such support is essential for certain types of intellectual effort, primarily basic research, where it is almost certain that private firms are able to capture only a small share of the benefits that their efforts produce. As a result, unless there is support from sources other than consumers, there is likely to be a substantial underprovision of such goods.[55]

It seem clear that a very large proportion of all basic research is carried out in ways that are unrelated to the profit-or-loss of the organization doing the research or the organization supporting it. In 1984, for example, Federal government support for research and development amounted to $44 billion.[56]

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[55] For a well-known statement of this proposition see K.J. Arrow, *op. cit.* Arrow argues, at 623, that "for optimal allocation to invention it would be necessary for the government or some other agency not governed by profit-and-loss criteria to finance research and invention." He points out, however, that "If the government and other nonprofit institutions are to compensate for the underallocation of resources to invention by private enterprise, two problems arise: how shall the amount of resources devoted to invention be determined, and how shall efficiency in their use be encouraged?"

[56] *Special Analyses, Budget of the United States Goverment, FY1985*,

3. EFFECTS OF NEW TECHNOLOGIES ON THE BEHAVIOR OF PRODUCERS OF INTELLECTUAL PROPERTY

Even when protected under the copyright, patent, and trade secret laws, the production and distribution of intellectual property is unlikely to be carried out in an economically efficient way. The nature of the goods being produced virtually guarantees that this will be so. The relevant public policy question is, therefore, not how can an economically efficient system to promote the supply of intellectual property be established, but how can a system that works in a satisfactory way be developed to achieve this objective.

For better or worse, the existing copyright, patent, and trade secret systems had previously adapted to the technologies in existence in ways that most parties found acceptable. Recently, however, a number of developments have called into question the ability of the existing systems to continue to balance the interests of producers and consumers of intellectual property. This section examines some of these developments in order to see how they are likely to affect the markets in which intellectual property is produced. The developments examined are: (a) the availability of low cost copying technologies; (b) the availability of telecommunications and computer systems that permit rapid access to large scale data bases; (c) the development of widespread access to computer technologies.

a. Copying

The right of an individual to copy by hand an entire book or article is seldom questioned. Yet the same copy, or one that is less extensive, made using a modern photocopying machine becomes the object of an intense debate about the respective rights of copyright holders and consumers. And with copying of computer programs using personal computers, or pre-recorded audio or visual material using tape or videocassette recorders becoming widespread, the debate has spread from

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at K-2. To be sure, not all research that is supported by government is basic research. Government support for other types of research may be justified, however, on the grounds that their benefits, like those of basic research, are non-appropriable, i.e., non-payers cannot be excluded from them.

the copying of printed material to encompass many other forms of intellectual property. Despite the intensity of these debates, however, the effect of copying, on both producers and consumers, is not widely understood.

Most discussions of copying characterize it as producing a conflict between the interests of producers and consumers of intellectual property. Copying, it is thought, benefits consumers, by permitting them to obtain copies at less than the cost of purchasing originals. Copying, it is thought, harms producers by reducing the number of originals that are sold. In this view, if additional copying is permitted, say by extending the scope of fair use, the welfare of producers declines and that of consumers increases.

One shortcoming of this argument should be readily apparent, however. If producer profits decline, it is reasonable to expect that fewer "first copies" will be supplied, at least in the long-run. Presumably those who recognize this relationship but still defend copying would argue that the value of the reduction in the number of first copies is small relative to that of the increase in consumer welfare that comes from the more widespread availability of those properties that are produced.[67]

A second shortcoming of the argument is more subtle. It results from the fact that producer behavior is likely to be affected by the existence of copying in ways that may offset any gains to consumers that result from copying. For example, under certain circumstances, an appropriate, i.e., profit-maximizing, response by producers to the existence of copying is to increase the price of originals.[68] If copying is inefficient, i.e., the marginal cost of a copy exceeds the marginal cost of an original, this will actually raise the price of using a copy above the price that would have been charged for originals in the absence of copying. In these cases, copying actually makes both consumers and producers worse off.[69] Here, the commonly-held view that the interests of consumers and producers necessarily diverge is not correct.

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[67] This is, in fact, a variant of the argument made by Plant.

[68] For a model in which this can occur see S.M. Besen, *op. cit.* A critical assumption is that the cost of originals and the cost of making copies are divided equally among the members of the group that "shares" an original.

[69] One might ask why copying occurs if it harms consumers. The

If private copying is efficient, at least in the short run it makes both consumers and producers better off. In this case, the effect of copying is to reduce the cost of using the intellectual property to consumers, but, because it is efficient, producer profits also increase. Here, as in the previous case the interests of producers and consumers are congruent.

Finally, where private copying is inefficient, the profit-maximizing response of producers may be to *reduce* rather than raise prices. Consumers benefit from the lower prices, but producer profits decline. Here, the commonly-held view that the interests of producers and consumers diverge is correct.[60]

Changing prices in response to the existence or the threat of copying is not the only possible strategy available to the producers of intellectual property. One alternative, or complementary, approach is to design products in ways that make copying more difficult. For example, computer software vendors are presently undertaking extensive efforts to develop technical schemes for "copy-protecting" their products.[61]

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reason is that consumers are unable to enter into enforceable agreements not to copy, so that copying will occur even if the price of originals is not increased. As a result, producers assume, correctly, that copying will occur and raise the price of originals accordingly.

[60] The results reported in the text are based on a model in which all originals result in the same number of copies. Where this is not the case, the conclusions are more complex. For example, efficient copying can make producers and at least some consumers worse off, if all consumers do not engage in copying. And, some consumers may be better off even if they engage in inefficient copying, if other consumers do not copy. A critical assumption is that producers cannot engage in price discrimination, charging higher prices to those consumers who copy than to those who do not.

It should also be noted here that the analysis of copying applies to other instances in which originals are shared, for example the rental of pre-recorded videocassettes. As noted above, the "first sale" doctrine prevents producers from charging prices to operators of video rental stores that are different from the prices charged to consumers who purchase pre-recorded cassettes for their own owe. As a result, profits may be lower than if video rentals were not permitted. If price discrimination were possible, the prices charged to video rental stores would rise and those to individual consumers would decline.

[61] For a comprehensive description of the types of technologies

What is significant about schemes for technical protection is that they interact with the pricing strategy adopted by the firm. If, for example, the existence of copying induced firms to raise their prices, and if copying can be prevented, or limited, by technical means, prices are likely to fall. This will increase consumer welfare and producer profits in the short run, since presumably producers will not wish to prevent efficient copying. Where producers lower prices to discourage copying, however, effective technical "fixes" will raise prices and make consumers worse off.[62]

A third strategy available to producers is to update their products more frequently than they would in the absence of copying. This is akin to the efforts by some textbook publishers who publish revised editions on a frequent basis, at least in part to undercut the market for used books.[63] If "upgrades" of computer software are made available on a frequent basis, and if there is value to having the latest version, more consumers will acquire originals instead of copies than if upgrades occurred less frequently. As in the case of technical "fixes," adopting this strategy may permit a lower price to be charged for originals.

Finally, producers can be expected to attempt to prevent unauthorized copying by bringing legal actions against infringers.[64] The effectiveness of such a strategy will depend upon the ease of detecting infringing uses and the magnitude of the penalties that can be levied on infringers. It is probably the case that copying by individuals for non-

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being employed, see N. Iscoe, "Technical Approaches to Software Protection: Current and Proposed," presented to the National Science Foundation Workshop on Protection of Computer Systems and Software, October 1984.

[62] There may also be significant distributional consequences. If technical protection schemes can be defeated by some consumers but not others, their existence may benefit some consumers while making others worse off.

[63] See H. L. Miller, "On Killing Off the Market for Used Textbooks and the Relationship Between Markets for New and Secondhand Goods," 82 *Journal of Political Economy* 612 (1974) for an analysis of this phenomenon.

[64] See "Lotus Settles in Copying Suit," 6 *Infoworld* 24 (October 29, 1984); "Maryland Firm Agrees to Pay in Computer Software Piracy Suit," *Washington Post*, *Washington Business* (March 19, 1984) at 15; and "Software Industry Escalates Its Battle on Program Piracy," *Wall Street Journal* (January 18, 1985) at 4 for examples.

commercial use, or copying in relatively small business establishments, will be difficult to detect. Widespread copying within large firms may be more easily identified. If copying can be limited in this way, the price of originals may be lower than otherwise. This will benefit those who did not previously copy but may make copiers worse off.

b. Access to Data Bases

One type of intellectual property that has become increasingly important in recent years involves the amassing of large amounts of information from a variety of sources in a form that makes accessing it relatively simple. The data can be in a variety of forms. They may involve the compilation of legal citations, or economic time series, or the texts of articles from the periodical literature. In each case, a user is saved the trouble of searching a large number of widely dispersed sources to obtain the limited amount of information that is actually needed. The firm that compiles the information and puts it in a form that facilitates access to it clearly supplies a useful service.[65] However, such a firm may be unable to be compensated for the services it provides if users can quickly and cheaply "download" all, or a large portion, of a data base to be used later without additional payments to the vendor, or to be sold to other potential users.

Modern technologies make possible the sale of data on a usage basis. Without the ability to cheaply and easily monitor usage, the only way in which data can be sold is to make an entire data base available for a fixed price. Computer technologies that permit usage to be measured make it possible to charge discriminatory prices and, perhaps, to provide data more efficiently. However, this advantage may be overcome by developments that lower the costs of communications and data storage.

In an important sense, the problem of downloading has much in common with the issue of copying, discussed above. Efficient production of data bases occurs where the value that consumers collectively place on having additional data available just equals the cost of providing it. Generally, access to a data base will be valued differently by different users, so that efficient provision will require price discrimination. This can be accomplished, at least roughly, by charging consumers based on the intensity of their use of the data base, with heavy users paying more than light ones.[66] However, to the extent that users can acquire an entire data base in a single transaction, to be searched later at their own convenience, the ability to discriminate may be lost. Similarly, if one consumer makes access to a data base available to others, the latter cannot be charged anything by the original vendor. The only pricing strategy available may be to charge high annual subscription rates, surrendering control over use to others.[67]

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[65] The relationship between compilers of data bases and the publishers of the materials that are compiled is considered below in the section on Derivative Works.

The ability of a data base vendor to practice price discrimination depends not only on the available technology, but also on the type of information being provided. If the data must be continually updated, the costs of downloading will have to be incurred frequently, so that it may be cheaper to acquire only those data that are needed. Here, sharing of data among users, or a strategy of "download and store," may be uneconomic.[68] Where data must be current to be useful, therefore, it is more likely that charges based on usage will be sustainable.[69] This suggests that contemporary economic time series, or current legal citations, or information from the periodical literature, may be protected more easily than can historical records or data.

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[66] Prices based on usage can only approximate the value of the data, since the same information will be worth different amounts to different users.

[67] There are, of course, other strategies, akin to copy protection schemes employed by computer software vendors. For example, some data base vendors have apparently reduced the rate at which data can be accessed, even though this increases acquisition costs, in order to discourage downloading. Others charge different prices depending on the rate at which data are accessed. Still others have bundled data with complementary inputs, e.g., computer software and economic models, so that customers obtain "results" rather than "data."

[68] Of course, if the costs of communications and storage are sufficiently low, these strategies may still be preferred to one in which data are acquired only as needed.

[69] This, too, has a parallel in the case of copying. Where, for example, a computer program is being continually modified and updated, consumers are more likely to purchase the product directly from the publisher, rather than sharing with others, with the inevitable delay in obtaining the most recent version.

c. Decentralized Access to Computer Technologies

Until the last few years, computers were either sold "bundled" with the software required to operate them or individual users developed their own programs.[78] In those cases where programs were developed to operate on many machines, it was usually straightforward to determine whether a particular program was being operated on a particular machine--typically its availability was "advertised" to the computer's users. Moreover, the identity of the developer or author of a particular program was relatively easy to discover. During this period, disputes about the ownership of programs and about the liability of users to developers of software were rare.

More recently, however, first with the development of minicomputers, and more significantly with the widespread use of personal computers, this situation has changed. The change has several dimensions. First, there has been an enormous increase both in the number of computer users and in the number of separate locations at which computers are operated. Second, there has been a substantial separation between the firms that manufacture computer hardware and those that develop software. Where computer manufacturers previously had felt it necessary to develop software to run their machines and to permit users to employ them, or users developed their own software, an entire industry now exists to provide software to computer manufacturers and users that do not develop any software of their own. In this connection, there has been a large increase in the number of general purpose programs--word processors, spread sheets, data base managers, and the like. Previously, most users were required to develop their own applications software.

Third, the substantially reduced cost of employing computers have made it possible for a very large number of individuals to participate in the development of computer software. Where once the development of software was carried out by the employees of a small number of firms, many users are today potential developers and sellers.

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[78] Of course there were exceptions. One example was the widespread use of multivariate statistical packages on mainframe computers.

The separation of the development of hardware from that of software, combined with the highly fragmented character of the software industry, has led to a problem that did not exist, or was extremely small, when software was marketed together with the mainframe computers on which it operated, or was developed by users for themselves. Firms that produce software must today earn enough revenues on software sales alone to compensate them for the costs of both the development and the production of their products. Even if we ignore the issue of private copying, i.e., copying by users, a computer software vendor faces the problem that other firms will be seeking to market products similar to its own and these may have been developed, at least in part, based on the contents of its own product. To the extent that a firm's development costs are reduced because it is able to "piggyback" on the ideas of others, its costs are reduced and its competitive position is improved.[71] But if such emulation becomes widespread, the incentives for the development of software may be reduced, since many of the benefits of innovative activity will be captured by other firms.

Firms faced with the possibility that others may emulate their products and bring them to the market at lower costs have a number of alternatives open to them. First, they may limit themselves to the development of products for which the advantage of being first is sufficient to generate revenues that cover all costs, including the costs of development.[72] This means that they must be able to satisfy a large demand during the period before their rivals can enter, for otherwise their first entrant advantage may be lost. They may also wish to undertake strategies that make entry by other firms more difficult, for example by setting prices lower than those that would prevail if there were no threat of entry.[73]

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[71] In the extreme case, other firms may simply copy, or make minor modifications in, the initial developers product, and attempt to market the product as their own.

[72] Thus, even if Plant is correct that production can occur without copyright, other products, less easily protected through "self-help", may not be made available.

[73] For a discussion of this strategy see A.M. Spence, "Competition, Entry, and Antitrust Policy," in S.C. Salop (editor), *Strategy, Predation, and Antitrust Analysis*, Federal Trade Commission, 1981.

Second, developers may undertake strategies that make "emulation" more difficult. By limiting documentation, by providing only object code, and by making available only the minimum information required to obtain a copyright or patent, the period of time over which the first entrant advantage may exist may be extended.

Finally, creators may bring legal actions for infringement against rivals. This strategy is costly to undertake, and may be difficult to sustain, but is likely to be part of the approach taken by firms against "emulating" rivals.[74]

d. Conclusion

Even where the law provides no protection to the creators of intellectual property, or where the enforcement of legal rights is difficult, producers of such property are not without means of protecting their interests. The effectiveness of these "self-help" efforts will vary among products, but in many cases they will be sufficient to sustain the viability of the producer. This does not mean, however, that there is no reason to extend legal rights or to facilitate their enforcement. The various efforts to protect intellectual property discussed in this section may not be equally effective for all producers. Moreover, they involve real resource costs, or the introduction of inefficiencies, that would not be present if rights in original creations could be more easily protected. Analyzing whether to create a right, or to promote the enforcement of an existing right, cannot be complete, therefore, unless these costs are taken into account. Thus, in analyzing the effect of reduced copyright or patent protection that is intended to make intellectual property more freely available, one must understand how producers will respond by seeking protection other ways and how effective these responses will be. It may often be more efficient to provide legal protection to creators than to require them to protect their interests through other means.

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[74] See Note, "Copyright Protection of Computer Program Object Code," 96 *Harvard Law Review* 1723 (1983) for a useful discussion of legal protection of computer software.

4. ECONOMIC EFFECTS OF THE LEGAL TREATMENT OF AUTHORS, PUBLISHERS, PACKAGERS, AND DISTRIBUTORS OF INTELLECTUAL PROPERTY

Much of the literature on the economics of intellectual property treats the process of the development and sale of such property as if an author/publisher/distributor markets its wares to an easily identifiable collection of users. In this simplified view, no distinction is made among the various components of the development process, implicitly treating them as if they are a single entity, or as if their interests are completely congruent. At the same time, users are treated as if they purchase and employ the product, but play no role in its development. There are important reasons why the usual economic paradigm, in which firms produce and users consume, may not be entirely appropriate in characterizing the intellectual property industry. One such reason is the fact that development occurs in many stages, not always within the producing firm. As a result, identifying a particular entity as either a producer or consumer is not always straightforward.

a. The Rights of 'Authors' and 'Publishers'

First, let us consider the effect of separating the interests of the "publisher" from that of the "author" of intellectual property.[78] For the moment, we abstract from the existence of uncertainty in the activity undertaken by the author. That is, we assume that the product that will be produced by the author is known before he undertakes his creative activity, and that the value that user place on the product is also known. We assume, further, that there is competition among publishers for the service of authors and among authors for the opportunity to be published. Under these assumptions, the return to the author will be the same whether he is an employee of the publisher or an independent contractor. Competition for his services will drive his "wage" to the value of his marginal product.

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[78] The designations "publisher" and "author" are used for convenience. They could as easily have been "manufacturer" and "inventor," or "producer" and "performer."

Now let us introduce uncertainty about the outcome of the author's creative process and about the value that consumers will place on it. Assume, however, that the probability distribution of outcomes is known to both author and publisher. That is, they know the possible values that may exist and the probability that each will occur. Now the determination of the return to both parties, and the form in which it will be obtained, is more complex. For example, if the author is risk averse, so that he desires an income that is not dependent on the outcome of his efforts, he can become an employee of the firm, at a fixed wage. Here, the publisher will obtain a large return if the author's efforts are highly successful, but it will incur losses if his efforts fail. The wage that the employee is paid may fall short of the expected return from his efforts, if publishers are also somewhat risk averse. If, however, many publishers are risk neutral, so that they are concerned only with the *expected* outcome, the amount of each outcome times the probability that it will occur summed over all outcomes, competition among them for the services of the author will produce a return for him that is equal to the expected return from his efforts. This is the same as the wage he would have received had there been no uncertainty.

Suppose, however, that the author wishes to gamble on the success of his efforts. Instead of working for a fixed wage, he can offer his product to the publisher on a consignment, or royalty, basis, so that he receives little or no return if his product fails and a large return if it succeeds. Alternatively, he can be employed by the firm, but in a way that makes his "wage" dependent on the success of his efforts. If the author is less risk averse than is the publisher with which he contracts, this will be the preferred alternative for both parties.

The discussion to this point has omitted an important consideration. The manner in which the author and publisher obtain their rewards may affect both the creative efforts of the author and the efforts of the publisher to market his creations. For example, it is not reasonable to assume that the efforts expended by the author are the same whether he works for a fixed wage or has his income depend on the success of his efforts. Similarly, the resources that the publisher expends in marketing will be greater if it need not share additional revenues with the author. What is produced, and how it is distributed, are likely to be affected by the compensation arrangement between publisher and author. As a result, the way in which an author is rewarded will depend not only on the willingness of the two parties to bear risk, but also on the need, that both will perceive, to encourage the other to expend his "best efforts."[76]

Where there are no legal impediments to contractual arrangements between author and publisher, we can expect the parties to arrange their affairs so as to allocate more of the risk to the party more willing to bear it, taking into account the need to assure good performance on both sides. The arrangment for risk sharing is unlikely to be "perfect", in that one of the parties is likely to end up bearing more of the risk than it would if there were no need to assure good performance. But the parties can be expected to do the best that they can under the circumstances. The question naturally arises as to how legal considerations affect this outcome. There are basically two cases.

In the first, the parties are free, if they desire, to shift rights from those that the law stipulates to others that the parties prefer. Thus, suppose that the law specifies that all work done by employees of a firm belong to the firm, unless the parties specify otherwise. If there is no arrangement to the contrary, an author-employee will work for a fixed wage, since he does not share in the ownership of the work. If, however, the publisher does not wish to bear all of the risk of failure, or if he wishes to create additional incentives for the author to be innovative, he may make part of the employee's reward depend on the success of his efforts. This can involve an explicit share of the returns from the products that the author develops. Alternatively, the arrangment can be implicit, as when authors who produce especially valuable products receive higher wages. In either case, the parties have agreed to give to the author some of the rights that the law has provided solely to the publisher. By a similar token, if the law provides that authors own all of the rights to their products, we can expect either that firms will not pay them a wage, or authors will attempt to obtain a wage by transferring all or a portion of their rights to publishers.

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[76] For this and other reasons, we would expect the wages of successful employee-authors to be renegotiated even in the absence of an explicit contractual provision to do so. This phenomenon, which also occurs in the cases of the salaries of athletes and television performers, is analyzed in B. Klein, "Borderlines of Law and Economic Theory: Transaction Cost Determinants of 'Unfair' Contractual Arrangements," 70 *American Economic Review, Papers and Proceedings* 356 (1980).

But what if there can be no transfer of the initial assignment of rights? Take the case where the law assigns the rights to the author. An author who wishes to bear less of the risk of success or failure, and obtain a larger proportion of his income in the form of a fixed wage, cannot do so if he is unable to transfer all or part of the ownership to the publisher. He must, therefore, accept more risk than he would prefer, since he cannot shift risk to the publisher. Similarly, if the law specifies that a publisher owns all of the products of his employees, and cannot transfer any of these rights to the authors, he may bear more risk than he would like, since the risk cannot be transferred to the authors. Moreover, it may be difficult in these circumstances to create appropriate incentives for creativity by authors, since their reward is independent of their efforts.[77]

One way to avoid this problem would, of course, be for all authors to be independent contractors, so that their products would not be works made for hire. By paying authors "advances," and giving them a share of the proceeds from sales, the effect of a work made for hire rule without transfers may be avoided. The success of this arrangement depends on whether it would be regarded as a subterfuge to avoid the effect of the law. Still another way that the difficulty might be avoided would be to make clear to author-employees that their future wages depend on the success of their present efforts.

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[77] A similar analysis applies to the case in which the law transfers inalienable rights to performers in uses beyond those of the original producer. Where the producer can acquire these rights, he may do so and pay performers a higher initial wage than if such rights could not be acquired. Where performers must retain these rights, their wages can be expected to fall by the value of the rights that are retained. If there is no uncertainty, only the form in which the performers' wages changes, with smaller payments from the initial producer being offset by the payments for the rights that are retained. If there is uncertainty, performers may bear more risk than otherwise.

The conclusion of this analysis is that, so long as rights can be transferred, there is no significance to their inital assignment. If the initial assignment places too much of the risk of the success of the venture on one party, subsequent negotiations will result in a transfer of some of the risk to the other.[78] Only where the law restricts transfers, can the initial assignment significantly affect the outcome.

One important example of a restriction on the transfer of rights occurs in the case of network television programs. Federal Communications Commission rules prevent the three major television networks from acquiring rights in the syndication of programs produced by independent suppliers after they have appeared on the network. Prior to the adoption of the financial interest and syndication rules, it was a common, although not universal, practice for the networks to acquire, at the time that a contract was negotiated for network exhibition, the right to act as the sales agent for the program in the off-network syndication market and to share in the revenues from off-network exhibition. Such practices are now forbidden by FCC rules, so that a supplier that wishes to reduce its risks by accepting a larger proportion of its return at the time the initial deal is struck cannot do so. However, the networks are able to acquire other rights in the programs, e.g., foreign exhibition, associated merchandise sales. The financial interest and syndication rules do, however, represent an example of a restriction on the transfer of rights in intellectual property.[79]

One additional point should be noted here. The previous discussion proceeds on the assumption that the uses of a product are known at the time that the contract between author and publisher is being negotiated.

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[78] This assumes that the costs of consummating transactions are not great. Where such costs are large, the final distribution of rights will be the same as the initial assignment. Such an outcome seems unlikely for dealings between "authors" and "publishers."

[79] The rules were initially justified by the FCC on the grounds that they prevented the exercise of monopsony power by the networks in their dealings with independent suppliers. For a criticism of the rules see S.M. Besen, T.G. Krattenmaker, A.R. Metzger, and J.R. Woodbury, *Misregulating Television: Network Dominance and the FCC*, University of Chicago Press, 1984.

However, as pointed out in *From Gutenberg to Telidon, A White Paper on Copyright*,[80] "changes in technology...may allow [a] work to be exploited in a completely new fashion beyond either party's anticipation at the time the work was created." The result is that the initial assignment of rights may govern such unanticipated uses, since no one will have thought to renogiate them at the time of the initial contract. Thus, an employer-publisher may own all rights to a product except those specifically transferred to an employee-author, so that all windfalls that arise from unanticipated uses accrue to the publisher.

Suppose, however, that it was believed that there would be some unanticipated uses of a product, but that it was not known precisely what these uses would be. Under these circumstances, the author could presumably either negotiate a higher wage than if these potential uses did not exist, or he could contract for a share of the earnings from all uses not specifically designated in the employment contract, or he could reserve rights in all unspecified uses for himself. Thus, the fact that all future uses of intellectual property cannot be anticipated does not necessarily mean that such uses cannot be taken into account in contracts between authors and publishers.[81] The relevance of legal treatment extends only to instances where the respective rights of the author and publisher have not been specified in the contact between them, or where the law restricts the rights that can be transferred.

It is also important to recognize why publishers might negotiate for a broader range of rights than the right of first publication, and why authors might grant them. One reason is that authors, by transferring rights to publishers, are able to reduce the risk that they undertake. To the extent that publishers can more easily bear risk than authors, because publishers' exposure is spread over a number of different products, both parties can be made better off by the transfer.

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[80] Government of Canada, Consumer and Corporate Affairs Canada and Department of Communications, 1984, at 114.

[81] This is not to suggest that assigning values to uses that are unknown at the time of the initial negotiation is straightforward. But the fact that such uses may arise is known and can be incorporated into the calculus of the negotiating parties. One party can agree to accept a larger initial payment in return for surrendering all "windfalls" to the other.

In addition, since publishers' efforts may be important to the success of their venture, by permitting them to share in the rewards these efforts will be encouraged. It may be in the interest of authors to permit publishers to share in rights beyond those of first publication, if the publishers' efforts can affect the value of such rights.

Some publishers routinely obtain rights beyond those of initial publication. For example, it is standard practice for television networks to obtain the right of first refusal to "spinoffs" that result from series that they air. However, it is not standard for print publishers to retain the motion picture or television rights to books that they publish. One possible reason for the difference is that a network's contribution to the development of the characters in the spinoff are more important than the contribution of print publishers to the value of potential film rights. Granting some rights to the network may thus result in greater effort on its part in the development process.

It should be clear that the issue being considered here is quite general. Among the situations to which it applies are:

(a) the development of computer software, where the question involves the way in which the authors of software and the firms that market and distribute their products divide the revenues from their sales;

(b) the authorship of books, where the question involves the rights retained by authors in subsequent uses and those sold to the initial publisher;

(c) the production of motion pictures, where the question involves the rights retained by independent producers and those transferred to film distributors;

(d) the production of network television programs, where the question involves the rights retained by producers and those transferred to the networks;

(e) the production of artistic works, where the question involves whether the artist can share in the revenues from sales beyond the first; and

(f) the invention of technical processes or new products, where the question involves the rights retained by the inventor and those transferred to the user of his inventions.

In all of these cases, with rights freely transferrable, the returns to both "author" and "publisher" are unaffected by the way in which legal rights are defined. If the law does not permit some rights to be transferred, and if there is certainty about returns, the payment for other rights will be adjusted so as to leave the returns to both parties unaffected by the legal definition rights.[82] If there is uncertainty, and rights cannot freely be transferred, one party may bear more risk than is optimal.[83]

b. Derivative Works

The creation of knowledge is a cumulative undertaking. An author, or scientist, or inventor, is more productive because of the activities of those who have come before him. If those who create cannot take advantage of the work of others, the process of creating intellectual property would be far less efficient. However, if taking advantage of the work of others involves appropriating their work, the process of creation may be slowed, since the incentive to create will be lessened by the inability of the creator to capture the benefits of his efforts.[64] The problem is how to balance the need to permit building upon previous knowledge against the need to encourage creativity in the first place.

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[82] This could, in principle, result in a negative wage being paid to the author. Thus, for example, if the sale of movie rights is contingent on publication of novel, the author may have to pay for the book to be published if he cannot assign the movie rights to the publisher. Television program producers routinely accept payments for network television distribution that are less than their costs, because additional revenues may be obtained in the off-network syndication market.

[83] Still another possible case, not considered here, occurs where the law specifies not only that a right exists but also its value. This occurs, for example, if performers are granted inalienable rights in subsequent performances, say in jukeboxes, and the royalty payment for such performances are specified by law. Here, if the required payment exceeds the amount that would be determined by the market, the revenues obtained by performers can be either larger or smaller than if the value of the right were not specified, depending, in part, on the effect of the royalty on jukebox uses. For an analysis of this issue see S. Globerman and M.P. Rothman, *An Economic Analysis of a Peformer's Right*, Consumer and Corporate Affairs Canada, 1981.

Note that the problem of balancing does *not* occur under two sets of circumstances. First, if all users of a given set of knowledge are employed by the same firm, it is in the interest of the firm to permit unlimited use of the knowledge created by any employee. Since all of the benefits of unfettered use are internal to the firm, there is no reason for the firm to limit the ability of any employee to appropriate and build upon the work of any other.

Similarly, there would be no need to balance the interests of creators and users if there are no impediments to contracts among them. Thus, for example, if the creator could prevent any use of his product, a user who wishes to take advantage of earlier efforts can negotiate, and pay for, the right to do so. All benefits would be "internalized," as in the case where all activities take place within a single firm. Where access to information is especially valuable, and where there are no close substitutes, it will command a high price. And producers of information will be able to charge different prices to different users, depending on the value that they place on it.

Of course, for reasons previously discussed, the assumption of costless transactions is not plausible for intellectual property. Negotation over price requires knowledge of the value of the information being sold, but once the information is disclosed there may be no need to pay for it. And even if the law requires some payment, once disclosure occurs the buyer has an incentive to misrepresent the value of the information to him in order to pay a lower price. It follows that we cannot rely on private transactions alone to assure that the the use of previously developed information is optimal.[65]

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[64] He may also attempt to keep his creations secret, although that is a far more feasible strategy for industrial processes than for consumer products.

[65] One implication is that the extent of vertical integration, the combining of different "stages" in the productive process within a single firm, will be more extensive than if private transactions could easily be consummated.

Resolving the question of how to balance the need to encourage creativity against the need to permit widespread use of information is not easy. Although stating the principle that should guide the balancing is straightforward--provide protection to the point where the value of the additional knowledge created equals the reduction in the value of the usefulness of the knowledge caused by the restriction--applying it in particular cases is extremely difficult.[86] What the law must attempt to determine is which uses would occur if transactions between creators and users were costless.

The legal system has had to confront, and deal with, similar problems in the past. For example, whether the original author should have the right to control translations of his work, is an instance of the problem of balancing. And the copyright doctrine that it is "expression" and not "ideas" that is protected is an instance where the courts have struck the balance heavily in favor of users. The development of new technologies may have made the balancing more difficult, by making distinguishing between creators and users more difficult.

In a larger sense, however, the distinction between the use of information by final consumers and its use by those who wish to build upon it, so-called "productive" uses, is somewhat artificial. Airlines use information about weather conditions as an input to the provision of travel services, while weather services use the same information to provide improved or specialized weather analysis that they sell to others. Most users employ information as an input to some other activity, so that even consumers who employ the Yellow Pages are using the information that it contains in the provision of "shopping," or "dining," or "entertainment." Whether purchasers convert information into another form and sell the resulting product to others, or whether they use it within the purchasing household or firm, does not fundamentally change the issue. Thus, the traditional notion that fair use must be confined to "productive" uses, those where the information is converted to another form, is inappropriate. The use to which information is put is, by itself, irrelevant to the required balancing. Only if it is believed that denying access to "productive" users imposes larger costs than does denying it to final consumers is the traditional distinction a tenable one. Thus, in principle, a non-productive use might be held free of liability and, by the same token, a productive use need not escape liability on that ground alone.[87]

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[86] Note that the suggested approach is an "ex ante" one, of the type that Easterbrook suggests. See F. H. Easterbrook, "The Supreme Court 1983 Term, Foreword: The Court and the Economic System," 98 *Harvard Law Review* 4 (1984) at 21-29. The concern is less with how to reward creators for ideas that have already been produced, but rather with the effect of the system of rewards on the amount of creativity that will occur in the future.

In addition to the question of whether or not to require the permission of the copyright holder to create derivative works, there is the issue of whether unauthorized uses can be prevented. Recent technological developments may make it more difficult for copyright owners to enforce claims against producers of derivative works, even where the law provides for them to do so. The reason is that "derivative works" are often produced and marketed in ways that makes their sources difficult to identify.

Consider the following hypothetical: One firm makes long-run weather forecasts that it sells to farmers, who employ the forecasts to aid them in planting and harvesting decisions, as well as to other customers. An agricultural advisory service develops a computer algorithm that combines the weather forecasts with forecasts of the prices of agricultural commodities, data on the costs of various farming inputs, and information about a particular farm, to produce planting and harvesting recommendations. This results in a decline in the sales of weather data, since the purchases of weather data by many farmers are replaced by a single sale to the advisory service. However, the weather forecaster is unable to identify the advisory service as the source of its lost sales, since the output of the advisory service is planting and harvesting recommendations and not weather data. In short, the transformation of the weather data has been so complete that its role in producing the recommendations cannot be traced.[88] And, even if the forecaster knows that it is the advisory service that has caused the lost sales, it may have considerable difficulty in convincing a court that this is the case.

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[87] For similar reasons, the fact that a user is a non-profit institution, as opposed to a profit-making firm, should not be a consideration in determining whether liability should be imposed if promoting economic efficiency is the objective.

[88] See I. deS. Pool, *Technologies of Freedom* at 212-216 for an

In order to try to limit the use of its forecasts in ways for which it receives little or no compensation, the forecaster may integrate "forward" into the provision of advisory services. Since it is advice and not weather forecasts that are sold, no one else can use the forecasts to provide advice.[89] Alternatively, if the viability of the weather service is threatened by the decline in its revenues, the advisory service may be forced to integrate "backward" into weather forecasting, in order to obtain a needed input.[90] As a result of the difficulties in detecting and preventing unauthorized uses, therefore, there may be more vertical integration than would otherwise be the case.[91] In the extreme, weather forecasting services that do not provide advice and agricultural advisory services that do not forecast the weather may simply cease to exist.[92]

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interesting discussion of the copyright issues raised by the ability to use modern computers to copy, modify, and expand a given "text."

[89] This assumes that sales of weather forecasts are completely curtailed.

[90] This has some of the characteristics of the "bundling" strategy described above. A private good, advice, is combined with a public good, weather forecasts, in order to permit the financing of the latter.

[91] Even if the uses are authorized, vertical integration may occur if the return to the forecaster is thereby increased, since, from the point of view of the forecaster, there is no difference between an unauthorized use that cannot be prevented and an authorized use for which no compensation is received. That is, even if the balance is struck in favor of permitting some uses without authorization, creators can be expected to seek to prevent such uses.

[92] There are, of course, limits to vertical integration. To pursue our hypothetical, to the extent that weather forecasts are useful in a variety of endeavors, it may not be feasible for forecasters to integrate forward into all of them. An alternative would be for forecasters to enter into exclusive arrangements with those firms that combine the forecasts with other inputs to provide various services. Final customers would receive only the services.

5. ESTIMATING THE HARM FROM UNAUTHORIZED USES

Many owners of intellectual property recently have advanced claims of substantial economic losses as a result of unauthorized uses made possible by new technological developments. This section presents and criticizes a number of these estimates, but before doing so it is useful to address the question of why such estimates are needed.

If the sole remedy sought by owners of intellectual property were the injunction of unauthorized uses, estimates of harm would be entirely unnecessary. A household or firm wishing to make use of such property would be forced to reach an agreement with the property owner. There would be no harm to assess because owners would authorize uses only if they were made better off as a result.

There are, however, three situations under which estimates of harm may be necessary. First, if unauthorized uses occur before they can be enjoined, or if an injunction is held to be an inappropriate form of relief, the courts will have to assess the resulting damages to owners.

Second, as we have argued above, in determining the appropriate level of protection to afford owners of intellectual property, it is necessary to balance the need to promote creative activity against the desire to have the products of that creativity achieve widespread use. Striking this balance requires the determination of the effect of a change in the level of protection on the rewards to creative activity, since that is an important determinant of the amount of such activity forthcoming. Estimating the harm that results from a reduction in protection is, thus, a necessary element of the balancing process.

Finally, for certain types of intellectual property, it may be necessary, or desirable, for payments to rights owners to be set not in the marketplace, but by the government. An example of where this is presently done is the establishment, first by legislation, and subsequently by the Copyright Royalty Tribunal, of royalty fees to be paid by cable television systems for a compulsory license for the retransmission of broadcast signals.[93] Clearly, the harm done to copyright owners from uses authorized under compulsory licenses must be an element in determining the appropriate royalty fee.

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[93] I have argued previously, however, that the compulsory license mechanism is neither necessary, nor desirable, for cable television.

a. A Digression on the Meaning of Harm

One issue that must be addressed in determining the extent of harm is how to define it. Two possible definitions are suggested. Under the first, harm is measured by the reduction in the profits of the producer below their level prior to a new unauthorized use. Under this definition, harm does not occur if the unauthorized use leaves profits from all previous uses unaffected.[94] Thus, if books are sold only in hardback form, if a firm other than the intial publisher issues an unauthorized paperback version, and if it can be shown that hardback sales are unaffected, under this definition there is no harm. Similarly, if it can be shown that the retransmission of broadcast signals by cable television systems does not affect advertising revenues, or that none of those who copy a computer program would have purchased an original, under this definition the producer has not been harmed.

Under a second definition, harm occurs if the new use reduces profits below the level they would have reached had the producer been able to exploit the market served without authorization. To pursue the previous example, even if it could be shown that an unauthorized paperback edition did not reduce the profits from the sale of hardbacks, the profits that the publisher could have earned from paperback sales is a measure of the harm that results from their unauthorized publication.[95]

See S.M. Besen, W.G. Manning, and B.M. Mitchell, "Copyright Liability for Cable Television: Compulsory Licensing and the Coase Theorem," 21 *Journal of Law and Economics* 67 (1978).

[94] The Supreme Court majority in the Betamax case, Sony Corporation of America et al v. Universal City Studios, Inc. et al, 104 S.Ct. 774 (1984), appears to employ this definition, since in assessing harm from off-air taping it is concerned solely with whether taping reduces advertising revenues.

[95] An even more complicated situation arises where the invention that permits the unauthorized use also makes it possible for the publisher to exploit new markets. Thus, the availability of the VCR, while it permits off-air taping without the consent of the copyright holders of television programs, also makes possible the sale of prerecorded videocassettes.

Clearly, these alternative definitions can give very different answers to the question of whether an unauthorized use has harmed the property owner. The distinction between them must be kept in mind-in examining various claims of harm.

b. Some Estimates of Harm

This section provides some estimates of harm that have been presented by copyright owners in support of claims that additional protection is needed. Not all such estimates are presented, and attention is directed primarily to instances where serious attempts have been made to quantify the extent of harm.[96] The next section provides a critical evaluation of these estimates.

Recording Industry Association of America. Under the auspices of the Recording Industry Association of America, Alan Greenspan prepared an estimate of "the impact and implications of home audio taping on unit sales of discs and prerecorded tapes...."[97] Greenspan argues that

> From the available data, it appears that roughly half of the taping from borrowed records or tapes would have generated record or tape purchases had home audio taping not been possible. The data indicate that approximately 42 percent of the taping from owned records (mainly for car or office copies) would have resulted in purchases of additional records and prerecorded tapes. And, two-fifths of all the off-the-

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[96] A number of estimates of the harm resulting from the copying of computer software are reported in M.A. Tyler, "The Economic Consequences of Inadequate Protection: The Software Piracy Problem," presented at the National Science Foundation Workshop on Protection of Computer Systems and Software, October 22, 1984. None of these estimates appears to be based on a systematic analysis, however. For a report of a set of estimates of harm from computer software piracy in Great Britain see "Pulling computer-copycats' claws", *The Economist*, September 8, 1984, at 72. The methodology employed to obtain these estimates, which are substantially lower than those reported in the Tyler paper, is not presented. A recent estimate of the amount of copying that is substantially smaller than those reported in Tyler appears in "$800 million toll," 19 *Computerworld* (January 21, 1985) at 1,4. Future Computing estimates that U.S. software vendors lost $1.3 billion in revenues between 1981 and 1984 as a result of unauthorized copying.

[97] Statement of Alan Greenspan Re S.31 Before the Subcomittee on Patents, Copyrights and Trademarks, Senate Committee on the Judiciary, October 25, 1983, at 1.

> air taping probably would have generated record or tape purchases. Overall, this suggests that more than two-fifths of home taping was in lieu of the purchase of prerecorded records or tapes last year. This represents lost sales of approximately 32 percent of the total volume of record sales in 1982. This percentage of sales displaced by home taping is the equivalent in 1982 to lost record sales of more than $1 billion. In addition, sales are being displaced by taping over previously-recorded music or speech. As home inventories of recorded tapes grow, this will become an increasing source of retail sales displacement. It is difficult to estimate the size of this displacement owing to the multiple use of tapes, but it could easily have amounted to more than a couple of hundred million dollars in 1982. Finally, we estimate that this sales displacement depressed prices on all record sales by at least 5 percent ($160 million) below what they otherwise would have been. Hence, we estimate the overall retail dollar losses from home taping last year were more than $1.4 billion. (Id. at 6-7.)

The estimate of $1 billion dollars of lost revenues was derived as follows. Using survey data, Greenspan estimated that 42.6 percent of taping off-the-air or from owned or borrowed records or tapes displaced retail purchases. This amounted to about 98 million hours of displaced retail purchases, based on an estimate of the total amount of music hours recorded on blank tape. Since there were approximately 305 million hours of music recordings sold in 1982, Greenspan estimates that retail sales were approximately 32 percent (98/305) lower than they would have been without taping. Since retail purchases were about $3.2 billion dollars in 1982, Greenspan estimates a loss in sales of about $1 billion.

The conclusion that retail prices were reduced by "at least 5%" was reached as follows. Greenspan notes that "...the average price of pre-recorded tapes tracked the implicit price index for all consumer expenditures fairly closely through 1978 but, beginning in 1979, tape prices lagged. By 1982 the divergence had cumulated to 22%. Data collected for the years 1974 through 1979 indicate that gross profit margins were stable between 1974 through 1978, but dropped sharply in 1979 suggesting that the failure of tape prices to match consumer price increases in 1979 reflected competitive pressures such as home taping....We have used 'at least 5%' to provide a conservative estimate of how much of the retail dollar loss was attributable to depressed prices, since profit margin data for the past three years are fragmentary."[98]

Motion Picture Association of America. Under the auspices of the Motion Picture Association of America, Battelle Pacific Northwest Laboratories has estimated the magnitude of the royalties lost to copyright owners as a result of sales displaced by tape copying and off-air taping.[99] They derive their estimates as follows: First, they estimate a model of the demand for prerecorded videocassettes, the demand for blank videocassettes, and the demand for rented prerecorded videocassettes. Among the explantory variables in each equation is the price of the good, and those of each of the other goods. Thus, for example, the price of blank videocassettes appears as an argument in the demand functions for prerecorded and rented videocassettes.

Next, they determine a price for blank videocassettes "which greatly reduces blank videocassette sales."[100] They then use this price in their "model of the demand for prerecorded videocassettes to estimate the number of additional prerecorded videocassettes sold. Sales of prerecorded videocassettes approximately double. Thus, [they] assume sales of prerecorded videocassettes to those engaged in copying would double if the market for blank videocassettes largely disapears."[101]

Using this result, they estimate that "the number of displaced sales for 1982 would be about 1,103,000 units and for 1990 would be almost 11,240,000 units. Using an assumed royalty of $10 on each prerecorded videocassette, [they] obtain estimates (expressed in 1982 dollars) of lost royalties of $11,030,000 and $112,400,000 in 1982 and 1990, respectively."[102]

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[98] Attachment to letter from Cary H. Sherman to Sen. Charles McC. Mathias, Jr., December 12, 1983, at 4.

[99] F.J. Cronin, R.J. Ness, A.R. Wusterbarth, and J.L. Eisenhauer, *An Analysis of the Economic Benefits and Harm from Videocassette Recorders and Related Products*, August 1983.

[100] Id. at 84.

[101] Id. at 85.

[102] Id. at 85.

The same calculation is repeated to estimate the effect of off-air taping on the sale of prerecorded videocassettes. Their approach also predicts an approximate doubling of sales of prerecorded cassettes to those engaged in recording from television. Using this result, they estimate "royalties lost in 1982 of $26,860,000 and $19,300,000 for commercial and pay television, respectively; the comparable 1990 estimates are $273,700,000 and $196,700,000."[103]

International Federation of Phonogram and Videogram Producers. The IFPI reports that a survey conducted in 1979

> showed that an equivalent of 280 million LPs had been copied, which represented an approximate retail value of [$2,490 million]. During that year, only 74.5 million LPs and 25.2 million cassettes had been sold for a value of [$807 million]. The British Phonographic Industry has put forth a reasonable and conservative estimate based upon consistent evidence derived from the surveys that 25% of these private recording sessions replace the purchase of the LP, tape or single in question. The value of these copies, if sales had been made through normal retail outlets, would have been approximately [$622 million] in 1979, which is the equivalent of 70% of the value of retail sales during that year.[104]

The IFPI also reports the results of a study of the losses that result from the private copying of videograms in the United Kingdom. They indicate that a "tentative estimate of the extent of the losses to the video industry...[was that] the shortfall in revenue could be at least [$24 million] at the retail level and that the net loss to right owners could be in the region of [$9 million].[105] No details of the methodology employed to obtain this estimate are provided.

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[103] Id. at 83.

[104] G. Davies, *The Private Copying of Sound and Audio-Visual Recordings*, International Federation of Phonogram and Videogram Producers, 1983, at 60-61. The survey in question is *Tape Recording - Report on a Quantitative Survey*, prepared by the British Market Research Bureau Limited on behalf of the BPI (British Phonographic Industry) and the MCPS (Mechanical Copyright Protection Society), January 1980.

[105] G.Davies, id. at 69. The study was EIU, The UK Market for Home Video Products, 1982.

AIM Report. A number of estimates of the effect of home taping, and the methodologies employed to obtain them, are reported in J. Keon, *Audio and Video Home Taping: Impact on Copyright Payments.*[106] Keon first reports the results of a study of the British market performed for the British Phonographic Industry by the Chartered Accountant firm of Anna, Impey, Morrish and Partners (AIM). The study was based on surveys of taping by the British Market Research Bureau Limited (BRMB) in 1973, 1975, and 1977. "Rough estimates of the length of time of the music taped in-home were correlated with the average length of pre-recorded material to calculate the LP equivalent hours of home recorded music."[107] These estimates were employed in three ways to estimate lost sales.

First, the answer to a survey question on whether the respondent "would have bought the last music recorded if they had not taped it" was combined with the estimate of equivalent hours of home recorded music to produce estimates of lost unit sales. This was then multiplied by the average LP price to obtain an estimate of lost sales. For 1977, the estimate was between 63 and 98 million British pounds.

Second, data on blank tape sales and estimates of the proportion used for home taping were combined to obtain an estimate of the number of LPs recorded at home. The survey evidence on whether the taper would otherwise have purchased the LP was then used to produce an estimate of lost unit sales. This was then multiplied by the average LP price to obtain an estimate of lost sales of from 90 to 139.5 million British pounds.

The third estimate was obtained by comparing actual sales to those based on an extrapolation of sales using data from 1972 to 1974. This method produced an estimate of lost sales of 85 million British pounds.

Roper Survey. Keon also reports the results of a survey conducted by the Roper Organization for the National Music Publishers Association and the Recording Industry Association of America on the taping of music in the United States.[108] People who taped at home, whether from their own collections, from borrowed records or tapes, or from the radio, were asked how many records or tapes they saved buying as a result. "According to the respondents' figures, 90 percent of everything taped from sources other than their own collection would have been purchased if not taped in-home."[109] This translates into lost sales of 268 million albums and 213 million singles. However, this was regarded as an overestimate by Roper "which preferred to accept a potential sales loss figure of 14 per cent."[110]

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[106] Consumer and Corporate Affairs Canada, 1982.

[107] Id. at 17-18.

[108] Id. at 22.

c. An Evaluation of the Estimates

For a number of the estimates reported above, not enough detail is provided about the methodologies employed to permit a critical assessment. However, the others are subject to a number of shortcomings, most of which are shared by the various studies. These are discussed in this section.[111]

The basic methodological shortcoming of the previous studies of the extent of harm is that the studies do not clearly describe either the behavior of consumers or producers in the absence of copying.[112] Although some surveys ask consumers whether they would have purchased an original if they could not copy, the answer to this question is of limited usefulness if consumers do not know what the price of originals would have been if copying were not possible. And, by the same token, the process of translating lost unit sales into lost revenues is not possible without knowing the price that would have been charged for originals if there were no copying.

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[109] Id. at 23.

[110] Id. at 23.

[111] It should be noted that most, if not all, of the estimates of harm reported by Tyler, *op. cit.*, are based on estimates of the extent of copying of computer software for which there is no support. The survey undertaken by Future Computing for the Association of Data Processing and Service Organizations is intended to remedy this shortcoming. However, even better data on the amount of copying does not guarantee that resulting estimates of harm will be accurate.

[112] Many of the estimates also contain additional problems. For example, one critical parameter in the Motion Picture Association of America Study is not significantly different from zero. *Op. cit.* at 47.

In general, the profit maximizing price for originals will be affected by whether or not consumers are able to copy.[113] In some situations, the producer will raise the price it charges for originals, in order to take advantange of the fact that originals will be shared by several users. In others, the producer will reduce the price of originals, in order to make their purchase more attractive and to discourage sharing. Only in exceptional circumstances will the price of originals be unaffected.[114]

Since the price of originals will generally be affected by the existence of copying, the meaning of the answer that consumers give to the question of whether they would have purchased an original if they could not copy is ambiguous. Do they interpret the question to ask whether they would have purchased an original at the prevailing price of originals, or at the price that would exist if there were no copying? And, if the latter, how do they determine what the price would be?

Similarly, even if the number of unit sales lost because of copying can be estimated correctly, translating that figure into lost revenues is not straightforward. All of the estimates reported above employ the prevailing price of originals in making this calculation. However, if producers have raised prices to take into account the existence of copying, this procedure will overestimate lost revenues.[115] If producers have lowered prices to discourage copying, lost revenues will be understated.[116]

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[113] See S.M. Besen, *Private Copying, Reproduction Costs, and the Supply of Intellectual Property*, *op. cit.* for an analysis.

[114] The Besen model provides only one way in which the price may be affected. For a different approach to the same problem see I.E. Novos and M. Waldman, "The Effects of Increased Copyright Protection: An Analytical Approach," 92 *Journal of Political Economy* 236 (1984).

[115] Keon, *op. cit.* also points out that all of the estimates that he reports are based on retail rather than wholesale prices.

[116] Lost revenues are not, of course, the same as lost profits. Even if revenues decline because of lower unit sales, profits will fall by a smaller amount, since the costs of producing originals has been reduced.

Only the Greenspan study for the Recording Industry Association of America even addresses the question of the effect of copying on the price of originals. It argues, on the basis of the fact that, in recent years, record prices have lagged behind consumer prices in general, that taping has forced producers to set prices below what they otherwise would have been. If this is correct, the conclusion that the estimate of lost revenues presented is understated would also be true. However, a much more rigorous analysis of the determinants of record prices would be needed before such a conclusion could be accepted.[117]

d. How to Estimate Harm

In order to estimate the effect of copying, it is necessary to determine what would have been the situation if copying had not occurred. The criticism raised above to the various estimates of harm that have been made is that their explicit or, more usually, implicit counterfactual is not rigorously derived. That is, they do not proceed from a model of the market that provides an estimate of what would have happened in the absence of copying.

The model developed in Besen[118] does permit the determination of such a counterfactual.[119] The technique is to "calibrate" the model, using data on the number of copies made per original, the cost of copying, the cost of producing originals, the number of originals sold, and the price being charged for originals in the absence of copying. That is, given the values of these variables, one can estimate the demand for originals which, in turn, can be employed to analyze the effect of copying.

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[117] Keon, *op. cit.*, makes a similar criticism of some of the estimates made by AIM.

[118] *Op. cit.*

[119] Other models, which would lead to other counterfactuals, are, of course, possible. The point is that some model of the process is necessary if harm is to be estimated. Although the Batelle Study does have a model of the demand side of the market, it makes no attempt to determine the effect of rental and off-air taping on the price of pre-recorded cassettes, implicity treating it as exogenous.

The intercept of the demand curve can be determined using data on the price of originals, the costs of producing originals and copies, and the number of copies per original.[120] The intercept, together with the cost of originals, can then be employed to derermine the price of originals that would have prevailed if there were no copying. With data on the number of originals sold, the estimated intercept of the demand curve, and the number of copies per original, the slope of the demand curve for originals can be calculated. Together with information on the costs of producing originals, the market equilbrium that would have existed in the absence of copying can be estimated.

From this information, the effect of copying on the welfare of consumers and on producer profits can be calculated. That is, one can compare the actual equilibrium quantity and price of originals to the price and quantity in a simulated equilibrium without copying. By comparing consumer welfare and producer profits in the two situations, the effect of copying can be estimated.

The approach proposed here uses much of the same data as employed in making the various estimates of harm discussed above. The only additional information needed is the costs of producing and distributing originals and copies, respectively. However, it does not require consumers to indicate whether they would have purchased originals if they had not copied. Instead, the answer to that question is inferred from other data. The approach differs significantly from others by employing an explicit model to deduce the harm that results from copying.[121]

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[120] A basic assumption that permits this and other calculations is that producers attempt to maximize profits. For details of the model the reader is referred to the Besen paper.

[121] The approach can also be used to analyze the effect of video rentals, as well as other means of sharing originals.

6. POLICIES FOR INTELLECTUAL PROPERTY

It should be clear from previous discussions that there is no presumption that the market for intellectual property functions efficiently. There are three basic reasons for this. First, non-payers often cannot be excluded from using such property, so that producer revenues will fail to reflect the value placed on their output by all users. Even where producers employ alternative methods of support, e.g., advertising revenues or the bundling of the intellectual property with other products, there is no presumption that the amount of intellectual property provided will be efficient.

Second, even where exclusion is feasible, producers usually cannot establish the differentiated prices required for efficient use. As a result, some consumers may be prevented from using a product even where there is no additional cost to serving them. At the same time, other users may contribute less to the production of the product than its value to them.

Finally, the market cannot be expected to provide the efficient variety of such products. Too little variety will result if producers find it more profitable to "duplicate" the products of other firms, rather than provide differentiated products. Too much variety will result where it is profitable to provide differentiated products but consumers place little value on the additional variety made available.

For these reasons, various types of government intervention have been proposed or employed in order to improve on the workings of the market. This section explores the advantages and disadvantages of a number of these policies. The basic conclusion is that, although private markets for intellectual property cannot be expected to function efficiently, none of the alternatives is without its flaws.

a. Defining Property Rights

The simplest type of government policy for dealing with intellectual property is to assign rights to the producers of such property and to rely on private enforcement of those rights through civil litigation. That is, property rights holders would be required to employ the courts to either enjoin unauthorized uses or to collect monetary damages when infringements cannot be enjoined.

Under such a system, rights holders would be expected to employ various forms of "self help," including pricing, marketing, and technological protection strategies, but the legal system would provide a complementary form of protection. Moreover, where the cost of enforcement of property rights is great, i.e., where it is difficult to exclude non-payers, property owners can be expected to adopt mechanisms for collecting revenues other than from direct sales to users. Thus, advertiser support and the bundling of intellectual property with other goods are often employed by vendors of such property, even where their property is protected by copyright.

In addition, under this arrangement it is not uncommon for rights holders to combine their efforts in enforcing their rights and collecting for uses. Entities such as ASCAP, BMI, and the Copyright Clearance Center[122] owe their existence to the fact that there are economies of scale in the enforcement of rights, so that the costs of enforcing the rights of a number of different holders through a single organization are smaller than the combined costs of enforcing those rights separately.

The obvious problem if such a system were adopted is what rights should be assigned and for what period. That is, even if this approach were adopted as the entire "solution" to the intellectual property problem, unless it is determined that all rights should be assigned to the creator in perpetuity--assuming that is feasible--it is necessary to determine precisely what rights are to be protected and for what period.

For example, should patents extend for 17 years, or for some longer, or shorter, period? Should authors have the right to control the preparation of translations of their work? Should limited non-profit copying for scholarly purposes be treated as fair use, and thus not an infringement? Should the algorithms contained in computer programs be protected "expression" or unprotected "ideas"? Is off-air taping of advertiser-supported programs for purposes of time shifting an infringement?

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[122] See A.F. Spilhaus, Jr., "The Copyright Clearance Center," 9 *Scholarly Publishing* 143 (1978) for a description.

Presumably the answers to all of these questions, if the objective is to promote economic efficiency, depend on a balancing of the additional rewards to creators made possible by the expansion of their rights, and the amount of additional creative effort forthcoming, against the losses to consumers from more restricted uses of intellectual property already produced.

As we have argued above, striking this balance correctly in any particular instance is a formidable undertaking. Some have argued that in most, if not all, cases, the optimum should be struck with few, if any, rights afforded to creators.[123] Others have argued for extensive rights for creators. But however the balance is struck, this approach has the virtue, once rights have been defined, of placing the entire burden of their enforcement on the owners of those rights. If the harm done as a result of infringements is large, this creates a large incentive for their enforcement. Where infringing uses cause little harm, they will be ignored. Moreover, this approach maximizes the incentives of creators to find private mechanisms for protecting the rights that they have.

b. Compensatory Levies Under Copyright Law and Government Collection Mechanisms

In order to overcome the difficulties in collecting from all users of a product, copyright holders have sometimes attempted to have the government collect revenues from users according to some formula, and to distribute the proceeds among rights holders in a similar manner, or to permit the rights holders themselves to establish collective compensation mechanisms. A common procedure is for a license to be granted to draw from a large collection of works, with the required payment based on the revenues of users or on the sale of some related good.

There are two principal justifications for the adoption of collective compensation mechanisms. First, copyright owners are often unable to collect directly from infringers, so that without these mechanisms they would receive no payments when their rights are violated. By permitting charges to be levied on recording equipment or media, infringing users can be made to compensate copyright holders. In short, these types of mechanisms sometimes exist because property rights cannot be enforced through the legal system. Private copying is an important example of situations in which enforcement is difficult or impossible.

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[123] See Plant, *op. cit.* and Breyer, *op. cit.*.

The second reason for adopting these mechanisms is that the decentralized nature of the infringements means that the harm from any given infringement is small. That is, any single infringement does not impose large enough costs on any single rights holders to make it worthwhile for him to attempt to enjoin, or collect damages from, the infringer. By combining the interests of different rights holders, economies in collective enforcement of rights can be exploited.[124]

In a number of countries, legislation has been adopted that provides for compensatory levies under copyright law.[125] Under such arrangements, owners of copyrights are given the right to demand from the manufacturers of recording equipment or recording media compensation for the reproductions made of their works. Thus, for example, in the Federal Republic of Germany, authors of audio and visual works can demand remuneration from the manufacturers of recording equipment based on the fact that the equipment will be used to make unauthorized reproductions of their works. This right must be enforced through collecting societies and each copyright owner must be permitted to share in the resulting revenues. The total payment to all rights holders is limited to 5 percent of the proceeds of the manufacturer.[126] In Austria, authors of audio visual works have similar rights as against manufacturers of blank tapes, with the amount of the royalty being established by law.

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[124] Frequently, of course, the two factors appear in combination. Where, as in private copying, infringements are decentralized, rights are both difficult to enforce and the losses from any single infringement are small. Note that not all such arrangements are the result of attempts by producers to minimize transactions costs. The compulsory license for the retransmission of broadcast signals by cable television systems was strongly opposed by program producers. The cable industry argued, however, that the costs of negotiating permission to retransmit these signals would be prohibitive, and this argument was apparently accepted by the Congress. An additional factor was that the level of the payment was set by legislation, and it was argued by program suppliers that the legislated royalty payment was substantially lower than the price that would prevail in the private market.

[125] See *Unauthorized Reproduction for Private Purposes Sound and Audiovisual Recordings, Broadcasts and the Printed Word*, prepared by the Secretariats of UNESCO and WIPO for a Group of Experts on Unauthorized Private Copying of Recordings, Broadcasts and Printed Matter, Geneva, June 4-8, 1984.

In Hungary, a somewhat different mechanism exists. Authors, performers, and producers of sound recordings share in the proceeds of a levy on the distribution of blank mediums. Significantly, the amount of the levy is established by the Bureau for the Protection of Authors' Rights and approved by the Ministry of Culture. The manner in which the proceeds are to be divided among authors, performers, and producers is prescribed by law.

In the United States, a compulsory license mechanism has been established to permit cable television systems to retransmit distant broadcast signals without having to negotiate either with the broadcast stations whose signals they carry or with the copyright owners of their programs. The license fee was originally established by law, but the Copyright Royalty Tribunal is empowered to change the fee under certain specified circumstances. For example, after the Federal Communications Commission effectively deregulated cable television, the level of the fee was substantially increased.

The Tribunal is also responsible for determining the distribution of the royalty fees among competing claimants, unless copyright owners are able to agree on the distribution. Until now, the Tribunal has been forced to allocate the fees among major groups--syndicated program producers, sports interests, and broadcasters--with the distribution within these groups being successfully accomplished by the parties themselves.

The variety of these mechanisms makes clear that there exists a large number of ways in which to determine the royalty fee. The law may give an organization of rights holders the authority to negotiate for a fee on behalf of its members, unconstrained by the government. It may establish the magnitude of the royalty itself. It may permit the fee to be negotiated subject to a ceiling contained in the law. It may permit negotiated fees subject to government approval.

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[126] For a description of the German system and the developments leading to its adoption see J. Reinbothe, "Compensation for Private Taping Under Sec. 53(5) of the German Copyright Act," 12 *International Review of Industrial Property and Copyright Law* 36 (1981).

Where the fee is determined by direct negotiation between users and rights societies unconstrained by government, the obvious problem is that, intead of competing with one another for the patronage of users, copyright owners have a collective interest in, and a mechanism for, setting prices anti-competitively. Indeed, if the collecting society is also responsible for distributing the proceeds of the royalty fee among its members, and if the costs of transactions among rights holders are not too great, all producers can be made better off by agreeing to the monopoly price in order to maximize joint profits.[127]

If the royalty fee is set at the monopoly level, there will, of course, be less sold than if prices were determined in a competitive market. Recall, however, that the purpose of establishing a royalty fee mechanism is to deal with the undersupply of the good that results from the inability of producers to collect from all users. Therefore, even if royalty fees are set at monopoly levels, the outcome may be less *inefficient* than if there were no mechanism for collecting fees. What this implies is that royalty fee arrangements in which fees are unregulated should be reserved for those cases in which it is likely that private markets functions very inefficiently.

At the same time, government establishment of the fees is not an especially attractive alternative. The government will often not possess the information needed to establish the appropriate fee and will often be subject to political pressures to set the fee for the benefit of one party or another. In this connection, the American experience with the establishment of compulsory license fees for cable television by the Congress and the Copyright Royalty Tribunal is not especially comforting.[128]

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[127] Note that it is not possible to resolve this problem by providing for separate negotiations with each producer. Unless a collecting society, or similar organization, can negotiate for all producers simultaneously, any single producer can improve his situation by "holding out," refusing to grant a license to use his products unless he obtains a large share of the benefits from the agreement. But all producers have the same incentive, so that no agreement may result. The economies that come from collective negotiation thus result not only from the savings of the cost of many transactions, but also from the avoidance of this "holdout" problem.

[128] Where the fee is set by private negotiation subject to a

It should also be noted that, whether royalty fees are set by the government or by negotiations involving collective rights organizations, certain types of inefficiencies are almost certain to be introduced. For example, if royalties are established on blank videocassettes in order to compensate television program producers for infringing uses, the royalties will also be paid by those who use videocassettes for non-infringing uses, for example, the taping of programs that are not copyrighted, or family or social functions. The result may be to discourage some non-infringing uses, which would be inefficient.[129]

c. Direct Government Support

Given the inefficiencies that are associated with the production and distribution of intellectual property through private markets, it has been argued that, for at least some types of intellectual property, a superior system would be one in which production is supported directly by government. This view is especially held by those who believe that the inefficiencies lead to substantial undersupply of invention and creative effort.[130]

Although this arrangement will lead to efficient use of whatever is produced, there is no guarantee that what will be produced will be efficient. After all, the government must determine what will be produced, and it will have few, if any, market signals to guide its

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governmentally imposed maximum, or where the privately negotiated fee must be approved by the government, unless the ceiling set by the government exceeds the monopoly price, it is likely to become the *de facto* price. Thus, those systems suffer from the same shortcomings as does an arrangement under which the government sets the fee directly.

[129] This is not to say that the fact that taxing these uses is inefficient is dispositive. It may still be desirable to impose a royalty even where some efficient uses are discouraged. But these inefficiencies must be taken into account in determining whether to impose the royalties in the first place, just as the inefficiencies from monopoly pricing must be considered in judging the desirability of rate setting involving collecting societies.

[130] See, e.g., K.J. Arrow, "Economic Welfare and the Allocation of Resources for Invention," *op. cit.* The view that the market will undersupply information is strongly criticized in H. Demsetz, "Information and Efficiency: Another Viewpoint," 12 *Journal of Law and Economics* 1 (1969). Demsetz, *op. cit.* at 12, argues that "the practice of creating property rights in information and allowing its sale is not clearly inefficient in comparision with [its real alternatives]."

efforts. Moreover, the interests of government officials cannot necessarily be presumed to be congruent with the promotion of economic efficiency. That is, those projects that are most able to obtain political support are not necessarily those that make the greatest contribution to economic efficiency. Nevertheless, there may be certain types of creativity that are so poorly supplied by the market that government intervention of this sort is required. Since undersupply is likely to be most prevalent in the case of basic research, where the appropriation of benefits by creators is most difficult, it may be desirable to confine government support to this area.

In addition, basic research is an area in which it is likely that the benefits of widespread dissemination are especially great. For this reason, it may be desirable to attempt to promote the creation of new knowledge in these areas by a system that does not rely on limiting use to provide rewards to creators.

Nonetheless, one should be leery about using government support as "the" solution to the intellectual property problem. Government is itself likely to be quite inefficient in carrying out this task so that the other approaches discussed above, private provision and collective royalty arrangements, will have to play a role in any well-designed system. The problem, and it is an enormously difficult one, is to determine the appropriate role for each.

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THE CHARACTER OF INFORMATION: Characteristics and Properties of Information Related to Issues Concerning Intellectual Property

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or less efficiency. Now there are two basic attributes about a person that affect the efficiency of achieving an outcome -- 1) The ability to choose among alternative ways of achieving the outcome, and 2) The capability to make sure the choice succeeds. Returning to the shopkeeper, the outcome is keeping rain off the merchandise. Informing the shopkeeper of the possibility of rain changes his choices -- he can now know to protect the merchandise before it rains. But having chosen to, say, cover an outside table with plastic, his capability to keep the plastic in place (using lead weights or whatever) also determines the efficiency of achieving the outcome. For if the plastic were to blow away the efficiency of protecting the outside merchandise has gone to zero. If information affects the basis for choice, what affects the capability of ensuring success? Success comes from practice, instruction, and other activities that affect capability.*

Thus the fundamental function of information in human activity is to affect the efficiency of achieving outcomes. The effect need not always be positive for if I am poorly informed, I will make less efficient choices and my efficiency will decline.

By defining information in terms of outcomes, the value of information follows immediately. Take the expected value (EV) related to achieving an outcome -- this is the sum of the probability of each

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* In accounting for the shopkeeper's actions we said, as a result of the information about rain, he could now "know" to protect the merchandise. The literature on information often refers to the related term knowledge. Indeed, Macklup's general term in his writings is the word knowledge rather than the word information (Macklup; 1962, 1980, 1984). Also, Lamberton's anthology of writings was on "economics of information and knowledge" (Boulding, 1971, etc.). With the concepts introduced so far we can relate information and knowledge.
A person's "degree of knowledge" is his efficiency in achieving an outcome by making choices -- i.e. his ability to make good choices. Information -- by informing the person of possible choices and their relative potential for achieving outcomes -- improves a person's degree of knowledge (cf. Ackoff, 1972, p. 48).

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changes in the probabilities of choice). (cf. Ackoff, 1972, p. 144).

Mackaay (1982, p. 107) states, "[i]nformation is the essential ingredient in choice..." Cherry (1966, p. 170) states, "Information can be received only where there is doubt; and doubt implies the existence of alternatives -- where choice, selection, and discrimination is called for."

At the recent Elsevier Symposium on Information Policy and Scientific Research, Manten and Timman examine "external" and "internal" definitions of information. An external definition of information presented by Vinken (Manten & Timman, 1983, p. 154) defines information as something someone is willing to pay for. Internal definitions of information are typically: "Information consists of data, that change the world view of the receiver" (Manten & Timman, 1983, p. 7). The internal definition is rejected because "it is impossible to say which data are information and which are not."

The above definition, however, is not an internal definition but a different and more fundamental external definition. The problem with the strictly economic external definition is that it excludes all information for which pecuniary (monetary) measures are inapplicable and all information which a person wouldn't pay for. For example, if I inform my daughter that she must stay in at night, I doubt she would pay me for that information. Manten & Timman, similarly, reject the external economic definition.

We can also define communication as:

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outcome (cf. Ackoff, 1972, p. 100).
A song provides the listener with a synthesized experience that temporarily replaces (or becomes) "reality." The experience can be mainly vicarious, mainly empathetic, or both. If it is vicarious, the experience substitutes for one's own; if it is one of empathy, the experience becomes like a close relationship to another. There are two behavioral effects of these experiences 1) The positive and negative feelings can be "consumed", for example, a stirring piece of music can evoke exhilaration and that can simply be felt, and 2) The feelings evoked can influence future choices. Feelings influence choices mainly by becoming attitudes. For example, marching music can be used to build up strong attitudes of nationalism. A strong nationalistic attitude will then result in loyalty to country and other forms of patriotism. Thus a song is partly information but not obviously so. A song, by creating synthesized experiences, creates feelings and attitudes that influence choices to achieve outcomes and is, therefore, by definition information. Songs also are motivational (i.e. produce changes in a person's values) and are consumptive goods -- to be enjoyed for the immediate sensate.

A Textbook -- Textbooks are subject to copyright. The material in the textbook directly changes the reader's available choices through the knowledge that it brings the reader. For example, if the reader needs to show a correlation between crop growth and rainfall there are varying degrees of efficiency he can achieve in obtaining the outcome -- a statement of the correlation. He might have no notion about how to go about making this statement. A textbook on statistics would provide information about the technique of regression analysis and the R^2 term that expresses correlation as a number from 0 to 1. With this new information, the reader would choose that analysis and his efficiency would significantly increase. (His capability may still be low and require practice and instruction to be very efficient in achieving a correct outcome.)
Thus, a textbook squarely fits the definition of information.

In summary, while most intellectual property is mainly information, there are exceptions. In particular, music, movies, and similar products that create synthesized experiences are part informational, part motivational, and part consumptive. Further, the proportion of these three components depends on the response of the viewer or listener.

What remains is the question of what is it that intellectual property rights are really given for. As technology continues to change

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could deal with issues of imitations, replicas, and partial copies. As a guide, it would be useful to compare court decisions on copyright and patent infringement with the evolving theory.

1.3 Conclusion

The definition of information permits us to identify the extent that information is embodied in intellectual property. The value of information follows readily from the definition. The definition, by tying messages to outcomes, is not suceptible to the problems associated with definitions of information that are defined in terms of bits. The definition is also a reasonable extention of the common use meaning of the word.

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value -- it aids in attaining desired outcomes. We thus refer to information as an intrinsic co-producer. Information inherently is a co-producer of outcomes. New information works in tandem with the knowledge already possessed by the person and with the capabilities of the person to achieve outcomes. The same applies to groups, families, firms, and other organizations.

There are many classes of commodities that are co-producers. While we do consume pencils as they wear down, the pencil is a co-producer of the written word. Cosmetics are co-producers of romance and cars are co-producers of transportation. But all of these co-producers are dissipated as we use them. Perhaps the closest parallel to information is the chemical catalyst. The catalyst is not consumed in the reaction but accelerates the process. But even most catalysts become contaminated after a while and need to be replaced.

Some writers have termed information a resource (Levitan; 1980, 1982, Cleveland, 1982). A resource is something that can be drawn on for help. Most resources are depleted with use -- oil, iron ore, etc. A non-depletable resource such as solar power is a closer analogy to information.

Cleveland (1982, p. 36.) describes two characteristics of information that are directly related to intrinsic co-production. Cleveland refers to the "expandability" of information. "[I]nformation expands as it is used." Information is co-productive of more information -- knowledge builds upon existing knowledge and news often repackages older information with newer information. The proliferation of information has been referred to as the information explosion and has resulted in "information overload." Indeed, the production of information

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two hours (and $2.00 of basic cable service can occupy days of time).

The economic significance of this characteristic of information has not been specifically studied. In general, it would operate to reduce the demand for information. Reduced demand would work against the potential for economies of scale (cf. 2.1.4).

In summary, we can define the time-constrained consumption of information as:

> Time-Constrained Consumption -- The character of information to occupy more consumer time per dollar expenditure than other commodities.

Reduced demand would result in reduced prices, making the value of information as property less valuable to its owner.

2.1.3 High Investment to Reproduction Cost Ratios for Information

The initial costs for creating information are high relative to the costs of reproduction. This contrasts sharply to most other goods where the production of multiple units of a good require considerable factor inputs of capital, labor, and materials.

Returning to the definition of information, the reason for this large difference relates to the necessary facilities needed to affect the choices in behavior. The informing process is mainly one of communication. Communication primarily consists of transferring audio and visual images. For the written word printed paper is quite effective and very low in cost. For motion picture images, the VCR cassette is less than $5.00 plus recording or pre-recording costs.

Equipment for accessing information such as VCR's, television monitors, computer terminals, and communication lines are not low in cost. If one amortizes the costs of these devices over the media costs, the reproduction costs are noticeably higher for some types of information.

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important to protect the owners of the investment (cf. 2.1.1.1 -- Appropriability).

2.1.4 Relevance of Information More Variable Across Consumers

There are various factors that determine the relevance of a good to a consumer. The most common factor is the consumer's preferences (or values). Consumer goods that are purchased out of preference are generally consumed again and again. Further, while many goods are slightly differentiated by styling, the demand for many basic goods is consistent across consumers. Combs, pencils, shovels, lumber, etc. are demanded consistently by many consumers.

Information, by contrast, is peculiarly different. The basic goods of information, such as the alphabet, vocabulary, etc. need only be consumed "once." The consumer does not generally go back for a second helping of learning arithmetic. He does go on to learning more arithmetic. Thus at any time, each consumer of information has a stock of knowledge that he or she is adding to and makes selections for more information based on an assessment of what further information is useful. Only when "memory fails" might the consumer go back and then usually to a familiar reference already on the shelf.

The "synthesized experiences" (cf. Section 1), if they are consumed again and again (like seeing a movie many times), become less and less information each time and more a simple consumptive good like food.

Thus, a second factor that determines the relevance of a good is its utility in building up a stock of knowledge. If the person reads something that is completely redundant to what he or she already knows, the material is not information at all -- for there will be no changes in the future choices of the individual as a result of the message. If the

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2.2 Market-Failure Related Characteristics of Information

The failure of markets has been a subject of public finance study for many decades. Market-failure and the role of government are closely entwined since a major role of government is to provide what the market cannot.

In the early part of the twentieth century, market-failure problems associated with transportation (railroads, trucking and airlines), communications (telephone, radio, and eventually television), public utilities (water, gas, etc.), and food, drugs, and cosmetics were closely studied and the associated industries were subjected to "economic regulation." In the mid-part of the twentieth century market-failure problems associated with health, safety and the environment were addressed with "social regulation."

Economics, as a discipline, primarily concerns the operation of markets. Market-failure, therefore, represents exceptions to the rules of the discipline. The basic concepts of Pareto optimality and cost/benefit analysis, however, transcend market operation and are thus useful economic concepts in the analysis of market-failure. (But even these concepts seldom address the form of market-failure associated with the distribution of wealth.)

In a short space it is not possible to describe all of the economic concepts related to markets and market-failure. To provide some common reference, however, the following terms are germaine:

Allocating Resources -- Using labor, raw materials and capital in production
Efficiency -- Allocating resources to their most valuable use (also called allocative-efficiency)

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a commodity and the subject of market-failure include Braunstein (1976, 1981), Levitan (1982), Mackaay (1982), Cooper (1983), and Priest (1984a, 1984b).

2.2.1 Public Good Characteristics

Public goods include goods like national defense, parks, and lighthouses. They are goods that multiple consumers can enjoy at the same time (sometimes referred to as jointness-of-consumption). Information also has the characteristic of a public good -- the use by one consumer does not prevent the use by others.

Public goods are often provided by government. Since consumers cannot be excluded from enjoying the benefits of a public good, use of tax-payer money to supply the good can be often justified. Economists and public administrators are quick to point out that government is not obligated to provide all public goods -- there are situations where the waste and distortion of government in trying to counteract the market failure results in more inefficiency than the original inefficiency (cf. Machlup, 1984, p. 157).

The market failure associated with public goods relates to the concept of marginal-cost-pricing described above. For maximum profit and maximum social efficiency, the firm should set the price of the good equal to the cost of producing the last unit (P=MC). But for a pure public good the cost of the last unit is zero and the firm should charge nothing at all. Thus for public goods social efficiency and private efficiency diverge. Pareto-optimality would be achieved only if the good were given away but then no firm could stay in business to produce it. (Baumol and Ordover suggest that the analysis is not this simple. "Resource allocation may benefit by the imposition of positive prices for public

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The major result of inappropriability is under-production of information. If the producer of information cannot appropriate its full market value the producer will only produce information where he can recover costs and make a profit. This results in fewer books, movies, information systems, etc. than is socially efficient (all other things being equal). Further, the types of information that are produced are distorted toward those types that can be subject to exclusion.

In summary, we can define the inappropriability characteristic of information as:

> Inappropriability of Information -- The difficulty in receiving full market compensation for the creation of information due to the problem of exclusion. The result is under-production and under-compensation.

Problems of appropriability have been recognized by Arrow (1962, 1971), Boulding (1971), Braunstein (1976, 1981), Cleveland (1982), Gordon (1982), Hall (1981), Macklup (1962, 1984), O'Brien (1980), and Priest (1984a, 1984b), and in inventive activity by Dutton (1984), Nordhaus (1969), Mansfield (1977), and Scherer (1977).

Cleveland (1982) refers to information as diffusive, easily shared, and transportable. He relates Colin Cherry's comment that information by nature cannot give rise to exchange transactions, only to sharing transactions (p. 37). Some of the positive effects associated with ease-of-sharing and transportability are discussed in Section 2.3 (Non-market characteristics).

2.2.1.2 Non-depletability

Information is a very durable good. It does not dissipate with use. It may become less valuable when "better" information is generated but the original information is still present.

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royalties set by a tribunal are unlikely to resemble real market valuations and will result in social inefficiency.

Solutions to Exclusion #2 are more difficult. The fair-use provision of the copyright law generally assures that exclusion will not occur. (For a most comprehensive discussion of fair-use and market-failure see Gordon [1982]).

Non-depletability can result in dwindling markets for information, particularly if new information cannot be readily generated. It is generally believed that extending the seventeen years of patent protection will not provide the inventor significantly more return on the invention's value. Within seventeen years newer inventions tend to take the older's place, but with notable exceptions such as xerography and the instant camera.*

2.2.2 Externalities

If there is an effect associated with a good -- positive or negative -- that is not accounted for in its price, there is an externality present. For example, the polluting of a stream by a pulp and paper mill represents a negative externality. The production negatively affects others and the good is more cheaply produced than if the pollution were controlled. We refer to internalizing the externality if there is some way to have the firm more fully account for such effects. A set of water quality standards could be established that the mill must meet by law. The presence of negative externalities was a major impetus for health, safety, and environmental legislation.

Information, in contrast, has few negative externalities, but significant positive externalities. The non-depletability character of information leads to positive externalities that extend for generations --

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* Patent life extensions have been suggested for products where government regulation delays the product's entry. FDA requirements can hold back a new drug or device for up to ten years.

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1. Intellectual and cultural values of science
2. The utility of basic research as the foundation of all technological development
3. Research as an essential component of graduate education
4. The high costs of scientific research, and the unlikelihood of adequate private financing (appropriability, risk, uncertainty)
5. The political values of science, especially in international affairs.

Positive externalities and appropriability are closely tied concepts. Whatever the producer of information cannot appropriate will be, by definition, a positive externality. The appropriability of invention (see 2.2.1.1) has been a subject of considerable research.

Nordhaus (1969, 1985) estimated the ratio of marginal social product to marginal private product using data on American agriculture. He calculated ratios of 12.7 for 1949 and 8.5 for 1959. These ratios imply very high social rates of return on research and verify earlier work by Griliches on the magnitude of the rate of return on hybrid corn. I.e., Nordhaus found very high positive externalities to agricultural research.

Mansfield (1977) performed an empirical study on social and private rates of return from industrial innovation. For seventeen innovations the median private rate-of-return was 25% (before taxes) and the social rate-of-return was 56%. Mansfield's ratio of social to private return was 2.2. The highest social return was 307% for a "thread innovation" (private return of 27%) and the highest private return was 214% for a "household cleaning device" (social return of 209%).

Calculations of positive externalities, at best, are fraught with methodological difficulties. Thus these data should be considered suggestive of the possible externalities associated with information.

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pour over old information in search for new. So not only do I incur the cost of purchase but also the opportunity cost of search.

In summary, we can define indivisibilities associated with the supply of information as:

> Indivisibilities (of supply) -- Information must be purchased in lumps; these lumps may be vastly greater than the information actually sought.

In terms of property, it is easier to provide legal protection for a large lump of information than many small pieces. This tendency will help perpetuate the generation of larger lumps. This is not socially efficient since the consumer is forced to purchase unwanted information.

2.2.4 Economies of Scale and Scope

For some goods, increasing a scale of operations results in decreasing costs per unit. This condition is called economies of scale and explains why so many of the goods we buy are produced by large companies.

As an example, Braunstein (1981) notes that daily newspapers have high set-up costs and low costs associated with the production of each copy printed. As a result, the vast majority of daily newspapers have no competing daily newspaper published in the same city.

Economies of scale are usually associated with production involving high set-up or fixed costs, decreasing unit costs, or both. If economies of scale are substantially present when the output of the producer is equal to the total market demand, there is the condition of "natural monopoly." A monopoly in these cases can be more socially efficient than competing producers. Unfortunately, the monopoly can make higher profits by under-producing and thereby inflating prices (Samuelson, 1973). Public policy towards this situation has been to permit the

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to 48%. In 1972 a full 15% of sales were made by firms smaller than the largest fifty. But concentration in distribution and marketing of recordings has occurred as the major recording companies have increasingly been relied on by independent recording firms for distribution.

Valenti (1982, p. 75) agrees with Homet about concentration in the cable area, [t]he 'Giants' are taking over the cable industry, concentrating power and increasing revenues." As of 1980 the 25 largest multiple system owners (MSO's) controlled over 60% of all U.S. subscribers.

Concentration and monopoly in telecommunications is not unexpected. Telephone was recognized as a monopoly and regulated in the first part of this century. The recent attempts to increase competition in telecommunications may be working against the condition of natural monopoly.

In summary, we can define economy of scale and scope with regard to the production of information as:

> Economies of Scale and Scope -- 1) decreasing unit costs when the scale of operation is increased; and 2) decreasing costs associated with joint production.

In relation to property, economies of scale and scope appear to mainly affect the distribution portion of the value-added process of information production. In those cases where property rights are given to independents and distribution occurs by "majors" there is little additional concentration effect. However, in vertically integrated firms that own both information creation and distribution processes, providing strengthened property rights will increase their monopoly.

2.2.5 Inherent Uncertainty and Risk in Information Production

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to justify the activity to stockholders or other investors.

Under these conditions of risk and uncertainty, information will be under-produced. The problem is exacerbated when the size of firms in the industry is small. Smaller firms have less capacity to handle risk and uncertainty. In contrast, firms like IBM and AT&T can "afford" some ventures that a smaller firm could not. Unfortunately, larger firms also tend to be more risk averse than smaller firms -- that is, they require greater potential return to risky ventures than a smaller firm does. Whether the degree of risk averseness of the larger firm negates its greater capacity to absorb risks is a point of current debate.

If individual firms cannot bear risks or uncertainty, in some cases it is socially efficient that society do so. "In operational terms this implies that the government do all R&D or that the government have R&D done by firms or individuals on cost plus contracts" (McFetridge, 1977, p. 16). Other mechanisms include partial subsidies and forgivable loans where the state bears part of the risk associated with a given project. Finally, some projects are too risky or uncertain even for society to undertake.

The public policy response to risk and uncertainty is fraught with unknowns and debate. The social rate-of-return must be sufficient to justify the risk and uncertainty. Thus, government tends to support basic science and R&D to a lesser extent. The greater the potential "co-productive capacity" of the resulting information (cf. 2.1.1) the more government involvement can be justified.

In summary, we define the risks and uncertainties in information production as:

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2.2.6 Information/Knowledge About the Information

Arrow noted a fundamental paradox in the determination of demand for information, "its value for the purchaser is not known until he has the information, but then he has in effect acquired it without cost" (Arrow, 1971, p. 148). If the seller could maintain property rights to the information this would not be a problem, but given problems of appropriability, "the potential buyer will base his decision to purchase information on less than optimal criteria (p. 148).

The problems of "search" is a well known related topic in economics (cf. Kwon, 1982; Stigler, 1971). Perfect competition presumes the presence of perfect information -- that all buyers are aware of all sellers, their products, their quality, and their prices. Perfect information does not typically exist and the result is inefficient: some products will be purchased at too high a price for their level of quality, performance, service, etc.

Information is subject to the problems of search but the problem is compounded by the appropriability problem discussed by Arrow. A producer of information will hide information to the extent that it is not appropriable. But hiding information greatly increases the problem of search. The less the buyer knows about a product, the less likely the buyer is to purchase it, or to purchase it at the "correct" price (the price under perfect competition).

To counteract this problem, producers of information rely on "brand recognition." Producers of information develop a reputation for the value of their information. For example, Standard & Poor is respected for its appraisals of the stability of firms and bond offerings.

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impact of an acute illness, an illness of three months or less, may in some circumstances be monetized but the impact of chronic illness cannot be monetized (Priest, 1981).

What is the monetary value of education, libraries, guidance counseling, or church attendance? All of these activities involve substantial levels of information.

Boulding (1971, p. 23) interprets the problem of intangibility as one of the problem of information measurement. "One longs, indeed, for a unit of knowledge, which perhaps might be called a 'wit', analogous to the 'bit' as used in information theory; but up to now no practical unit has emerged."

The problem of intangibility and measurement relates back to the definition of information. Information derives its utility by changing the efficiency of achieving outcomes by changing choices. An activity such as education involves millions of changes in potential choices. "Education produces possibilities." To faithfully arrive at the utility of education then I would have to consider two situations, the attainment of all outcomes without the education and the attainment of all outcomes with the education. I would have to measure the efficiency with which each outcome was achieved under the two conditions, and sum the efficiencies to attain a single value of merit. Further, I should perform this exercise, not after the impact of the education has been seen (ex post), but before (ex ante), because this is the circumstance in making the purchase. This means forecasting the efficiencies and outcomes under the two situations.

When a consumer is faced with purchasing education, however, it is exactly this calculation he must make to make the correct buying decision.

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costs of negotiation, contracting, and enforcement which exist even when exchange is bilateral" [first emphasis added]. Sometimes the term is misapplied to mean "the cost of transmitting information which has already been produced" (cf. O'Brien, 1980, p. 452).

In this discussion we refer to the second meaning of the term. In this sense, transaction costs and indivisibilities (cf. 2.2.3) are related. As we attempt to reduce indivisibilities by breaking information into pieces, we increase transaction costs as we attempt to appropriate its value.

In summary, we can define transaction cost and information as:

> Transaction Cost of Information -- The additional costs incurred by the producer in appropriating the value of information.

The reduction of transaction costs was the explicit goal of the compulsory licensing of distant signals by cable television operators. According to Ladd (1982, p. 946) in congressional testimony:

> ... it would be impractical and unduly burdensome to require every cable system to negotiate with every copyright owner whose work was retransmitted by a cable system. Accordingly, the [House] Committee [on the Judiciary] has determined to ... establish a compulsory copyright license for the retransmission of those over-the-air broadcast signals that a cable system is authorized to carry pursuant to the rules and regulations of the FCC.

Further testimony of Monroe M. Rifkin agreed:

> There are 4,350 cable systems, each carrying an average of five distant signals, (2 networks, 2 independents and 1 educational) each with a minimum of 6 - 17 hours of programming per day. Although it would be impossible to estimate the number of transactions that would be necessary, it is clear the the simple multiplication of 4,350 cable systems times 1,000 program suppliers seriously underestimates the probable number. While most program suppliers offer several programs, the number of contacts required to program five channels, 17 hours per day, 365 days a year would be enormous.

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property rights may ... reduce rather than increase the efficiency of a resource use (R. Posner in Gordon, 1982, p. 1608). Clearly a difficult balancing is required.

The granting of property rights such as copyright reduces transaction costs (cf. Gordon, 1982, p. 1613). Without such explicit rights, contracts would have to be established under common law. This process would be far more tedious and time consuming.

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Value -- Value is defined relatively. Relative value is determined in an "intention situation" as the probability that the individual selects the course of action that has a maximum efficiency for a particular outcome. (Where an intention situation is one in which (1) there are the same number of available courses of action and outcomes, (2) each course of action has maximum efficiency for one outcome and hence no efficiency for any other, (3) each outcome has associated with it one course of action that has maximum efficiency for it, and (4) the alternative courses of action are equally familiar, known, and understood by the individual relative to the possible outcomes.)
(This particular definition requires considerable patience to comprehend but (relative) value is a key concept.)

Capacity to Achieve -- The efficiency with which an individual achieves
an outcome using a particular course of action. (Proficiency)

2.3.1 High Intrinsic Relationship to Human Welfare

This concept is parallel to the High Co-productive Capacity (2.1.1) for the market. We begin with the basic behavioral science model of human behavior (cf. Ackoff, 1972). A choice is made from various courses of actions with an attendant outcome. Associated with an outcome is a relative value -- what the outcome is worth to the person, how well or poorly the outcome will make the person feel. The individual "models" the world by drawing on "beliefs" (inferences drawn from past and present perceptions). Using the model the individual attempts to predict the results of various choices. The individual is also guided by feelings and attitudes, as these represent "evaluations" of past outcomes in similar situations.

There are three basic components of behavior 1) Tendencies to choose certain actions over other actions, 2) An efficiency to which a particular course of action will achieve the outcome, and 3) The expected value associated with the outcome. As we defined in 1.1, information changes tendencies in choosing certain actions over other actions -- a

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action is held constant. Understanding is responsiveness to whatever affects efficiency. "If, for example, when a change occurs in the environment or the [individual] to reduce the efficiency of his behavior, he modifies his behavior so as to increase his efficiency; then he is said to understand what has happened." (Ackoff, 1972, p. 50) The response consists of 1) changing his course of action to another, 2) changing the capacity applied in the course of action, 3) or both. Understanding can be defined as:

> Degree of Understanding: For a set of possible actions and set of different capacities that can be applied to the actions, degree of understanding (of the individual) is the probability of an outcome compared with efficiencies of all other choices and applied capacity.

These definitions are at first counter-intuitive. We tend to think of knowledge and understanding as something the individual holds or possesses. Definitions of knowledge and understanding that are based on a state of a person's perception are too internal -- they provide no external verification of the knowledge or understanding. Here, however, knowledge can be ascertained by the appropriate choice of action and understanding can be ascertained by the appropriate choices of action and application of capacity. Furthermore, these defintions are operational. It is now possible to know whether and by how much some information increases understanding -- by changes in the degree of understanding.

In summary, the intrinsic relation of information to human welfare can be defined as:

> Intrinsic Relation of Information to Human Welfare -- Human welfare is a product of individuals and groups achieving desired outcomes. Thus, information is intrinsically related to human welfare in that it inherently facilitates the achievement of outcomes.

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intrinsically related to freedom. Governments of societies that restrict freedom find that they must restrict communication of information. They are attempting to maintain a certain set of choices and excluding others.

Privacy is mainly a problem of information and understanding. Perfectly upright citizens, who have "nothing to hide", insist that their privacy be protected. Unprotected privacy has two results 1) Interference due to unwanted publicity, etc., and 2) Interference due to mis-understanding, mis-interpretation, etc. We will concentrate on the second form of interference. Why does someone who has nothing to hide insist on privacy? -- because if there is 1) not full information about his actions, and 2) not full understanding of his actions, his actions may be misconstrued and the result may be defaming.

Thus a major issue with privacy is an "all or none problem." It is not possible to give everyone enough information to properly judge, therefore, information must be selectively made private to reduce the probability of misjudgement.

In summary, the intrinsic relationship of information to 1st amendment rights and privacy can be defined as:

> Intrinsic Relationship of Information to Freedom -- Information affects the range of choices available to the individual. Freedom is a lack of restriction on choices. Thus information leads to greater freedom.
>
> Intrinsic Relationship of Information to Privacy -- Incomplete information may result in defamation of character. Therefore, information must be selectively made private to reduce the probability of defamation.

Pool (1983) recognized the relationship between freedom and information in his Technologies of Freedom. In particular, Pool saw the regulation of the channels of communication under the FCC as abridging

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3. Relationship of Information to Products and Services

Talking about information is like talking about a calorie, no one buys a calorie, they buy food. To trace information as it becomes embodied in products and services one must follow the life cycle of information production.

A simple version of the life-cycle model has the following steps: Through the generation of information there is created an information source; then through institutionalization of the source there is created an information resource; then through maintenance & enhancement there is created information products & services; then through dissemination the information becomes used (Levitan, 1982, p. 47). For example, a reporter writes up a story; the story is sent to UPI; an editor picks up the story, combines it with other information in the files; a newspaper article appears; the newspaper is delivered to the front door.

More complex versions of the life-cycle model include various additional stages or components of "value-added" activity. Value-added can be considered in two ways. The strict economic definition can be defined as:

> Value-added -- The sum of the input factors of production excluding all purchases of materials and services from other firms.

Returning to the example of the reporter, the value added by the editor is his labor, some percentage of management's labor, and depreciation on the editor's word-processor. But as so defined, we have not included "intermediate inputs" of the business such as telephone service, office space, paper, etc.

This exclusion makes the economic definition of value-added appropriate to avoid double counting in performing the "national

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definition, there may be considerable value-added (labor, etc.) but the result, let us say, is confused, this added confusion would result in a negative value-added by the second definition. The individual would be better off consuming the information before the value-added step than after.

One technique to attempt a quantifiable measure has been the use of willingness-to-pay (cf. Griffiths, 1982, p. 274). In willingness-to-pay, the individual is being asked to quantify in dollars, the perceived value of the information. I.e., he is being asked to translate the incremental increase in expected value into dollars. Willingness-to-pay, as a measure is subject to large uncertainties but in some situations provides useful data. Let us consider two extremes. The individual is about to go to a $5.00 dance club. A promotion service (value-added) calls the individual and says there is a free $5.00 ticket to the same dance club waiting for him. The individual's willingness-to-pay for this information would be $5.00 (ceteris paribus). In another situation, an individual is chronically depressed, irritable, and angry. The individual is informed that central sleep apnea (a form of sleep disorder) can cause these symptoms. Subsequently, the individual is cured.

What is the willingness-to-pay of this individual? He might have hocked his soul. When intangibilities are high (cf. 2.2.7), there are significant externalities (cf. 2.2.2), or there is poor information about the information (cf. 2.2.6), willingness-to-pay is an unreliable measure of value-added.

Products and Services

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Table 3-1
Primary Activities of Information Industry Association Members

26	Document Acquisitions and Delivery (S)
26	Periodicals-publishers (P)
25	Publishing (P)
22	Consulting Services (S)
22	Data Bases - Design and/or Management (S)
22	Data Bases - Information (P) (Publishers of Information About Data Bases)
20	Indexing Publishing (P)
19	Data Bases - Searching (S) (firms that carry out data base searches)
19	Information Systems - Design and Evaluation (S)
19	Market Research Services (S)
18	Business Information (P)
18	Micropublishing
17	Current Awareness Services (S)
17	Data Bases - Vendors/Lessors (S) (Companies that Produce or Sell the Use of Data Bases)
17	Government Information (P)
17	Literature Searches (S)
16	Corporate Information (P)
15	Directories (P)
13	Abstracting Publishing (P)
13	Indexing Services (S)
13	International Business Info. (S)
12	Energy Information (P)
11	Abstracting Services (S)
11	Financial Information (P)
10	Marketing Services (S)
10	Software (S)
9	Scientific Literature (P)
8	Audiovisual Materials (P)
8	Cataloging Services (S)
8	Engineering Information (P)
8	Environmental Information (P)
8	Legal Information (P)
8	Television Information (P)
7	Clearinghouse (S)
7	Library Automation Services (S)
7	Medical Literature (P)
7	Newsletters-Publishers (P)
7	Typesetting Services (S)
6	ASIA (P)
6	Economics (P)
6	Electronics Information (P)
6	Forecasting Services (S)
6	Microform System Design Services (S)
6	Micrographic Services (S)
6	Records Management Services (S)
6	Reprint Publishers (P)
5	Accounting Information (P)
5	Agriculture (P)
5	Book Information (P)
5	Bookselling Services (S)
5	Chemical Information (P)
5	Computers-Hardware (S)
5	Conferences-Information (P)
5	Drug Information (P)
5	Education (P)
5	Europe (P)
5	Financial Information (Intl.) (P)
5	Information Industry (P)
5	Looseleaf Services (P)
5	Management Information (P)
5	Patent Information (P)
5	Product Development (S)
5	Social Science Literature (P)
5	Statistics (P)

(S) -- Service (P) -- Product Source: Cuadra, 1980, p. 98

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Taylor recenty completed a major work on the value-added processes in abstracting and indexing services (1984a) He notes that abstracting and indexing services do not alter input. The references, papers, documents remain the same. What they do is provide a "whole series of tangible signals and intangible values that make it easier for customers to make choices (p. 131). Taylor identifies 24 specific ways value is added by abstracting and indexing services. These are listed in Table 3-2.

Porat (1977) has developed the most comprehensive study of value-added in the economic sense. While the study provides little sense of what particular value is being added, it spans the entire information economy. (Recall also that intermediate inputs are not included.) He divides the information economy into two major sectors: the primary information sector -- "includes those firms which supply the bundle of information goods and services exchanged in a market context" (Vol. 1, p. 4), and the second information sector -- "includes all the information services produced for internal consumption by government and noninformation firms" (Vol. 1, p. 4).

For the primary sector, he presents value-added (VA) by two-digit SIC (Standard Industrial Classification) categories (Vol. 1, Table 4.8, p. 55). For example, VA in 1967 for Services: Motion Pictures is $1,525 Million; for Service: Educational - $5,170 Million; and for Communication: Radio Broadcasting and Television - $1,580 Million.

For the secondary sector, a similar table is presented but only at the one-digit level (Vol. 1, Table 9.2, p. 155). A second table is presented in the Appendices (Vol. 8, Table 10, p. 18-21) contains value-added at the two digit level. For example, VA in 1967 for all of

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Table 3-2 (Continued)
Value-Added in Abstracting and Indexing Services

Formatting (Ease of Use): the physical presentation and arrangement of data/information in ways that allow more efficient scanning and hence extraction of items of interst from the store.

Interfacing (Ease of Use): the capability of the system to interpret itself to users.

Interfacing (*Mediation*) (Ease of Use): the means used to assist users in getting answers from the system.

Interfacing (*Orienting*) (Ease of Use): the means used to help users understand and to gain experience with the system and its complexities.

Linkage (Reducing Noise): the value added by providing pointers and links to items, sources, and systems external to the system in use, thus expanding the client's information options.

Ordering (Ease of Use): the value added by initially dividing and organizing a body of subject matter by some form of gross ordering such as alphabetization, large groupings, etc.

Physical Accessibility (Ease of Use): the processes of making access to information stores easier in a physical sense.

Precision (Reducing Noise): the capability of a system which aids a user in finding exactly what he wants.

Reliability (Quality): the value added by the trust a system inspires in its clients by its consistency of quality performance over time.

Selectivity (Reducing Noise): the value added when choices are made at the input point of the system, choices based on the appropriateness and merit of information chunks to he client population served.

Simplicity (Adaptability): the value achieved by presenting the most clear and lucid (explanation, data, hypothesis, method, etc.) among several within quality and validity limits; not to be confused with 'simplistic'.

Stimulatory (Adaptability): those activities of an information system that may not be directly supportive of its primary mission, but which assume importance in establishing a presence in the community or organization served and which encourage use of the system and/or its staff expertise.

Time-Saving: the perceived value of a system based on the speed of its response time.

Validity (Quality): the valued added when the system provides signals about the degree to which data or information presented to users can be judged as sound.

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lead a good life. The value of these principles may be very great but highly inappropriable. But, in adding value by placing the principals into context in stories or screenplays, the information becomes bundled with synthesized experiences. These can be protected as property and the value is more appropriable.

A trend in computer software is to bundle software with further access to information. A user becomes a subscriber to hot-line advice, further enhancements, and consulting. This bundling increases the appropriability of the software since only registered users can be subscribers.

Unfortunately, bundling is not socially efficient from another perspective. It forces the buyer to purchase more than he may otherwise want, reducing allocative efficiency. It also can increase the monopoly power of an industry and produce serious antitrust issues. IBM was forced by the Justice Department not to bundle software with its hardware. The securities industry was forced by the SEC not to bundle their information services with the prices charged for stock transactions. Each form of bundling will have to be reviewed on a case-by-case basis, however, since there are no clearcut ways of predicting the affect of bundling on industry structure.

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4.1 Rewards, Incentives, and Funding for Science

Intellectual property in science mainly consists of journal articles, books, and some computerized databases on physics, chemistry, etc. While scientists are paid salaries, the relationship between this compensation and the incentives to create intellectual property is weak. In science, there is a distinctly different set of rewards and incentives operating.

Rewards and Incentives for Science

Gaston (1978) studied the reward system in British and American Science. His findings affirmed what generally has been believed that scientists are rarely motivated by salary or other compensation. Merton (1973) contributed substantially by describing the sociology of science -- the networks, communications, and relationships among scientists. Considerable motivation to produce can be traced to these linkages. Science is an uncertain process that depends on data and information from others. While scientists tend to work with some isolation, they are dependent on others for information and critique. Associated with this dependency has been a form of "work motivation" -- scientists are pleased to be cited in other articles, are pleased to be invited for a paper, and particularly pleased when their work leads to a "break-through." "In the scientific world the highest value is for the research speciality or parent discipline to develop through contribution of new data and theoretical explanations to account for the data" (Gaston, 1978, p. 3).

Merton suggests that four basic norms consitute the "ethos" of science and guide the behavior of scientists -- universalism, organized skepticism, communism, and disinterestedness. These norms help explain the scientist's detachment from pecuniary (monetary) rewards.

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becomes a proxy for success. Success is a recognized outcome in our society and the psychic rewards are high. This places an even higher relative value on outcomes that produce money. It is this pair of motivations that embraces the market system. It is also this pair of motivations that are considered narrow, sterile and unredeeming. Why so?

This relates to other cultural values whose purpose is to make sure that human welfare flourishes. If all human welfare could be produced by the market, there would be no tension, but because of intangibilities, externalities, etc. they cannot; fortunately there is a non-market process that ensures these outcomes -- the production of poetry, kindness, charity, human growth, and science.

Non-pecuniary rewards to motivate are thus tied with this set of other cultural values. These are values like "love of learning," "goodness to others," "courageousness," the "work ethic," etc. Through the process of inculcation, these values become part of an individual's values. The result is a high relative value placed on the generation of intellectual property that represents "contributions to society." Since these values, like the value of success in business, are recognized by society, the psychic rewards are high.

In addition to pecuniary and non-pecuniary motivations there is one additional aspect that affects the production of intellectual property -- the efficiency of the choice of action to achieve the outcome and the efficiency of achieving the outcome by that particular action (proficiency). The first efficiency is affected by information, and instruction and practice affects proficiency (cf. Section 2.3).

Copyright is to pecuniary rewards what plagarism norms are to non-pecuniary rewards. Copyright gives possession and increases

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Abuse is curbed since the award of future grants and contracts are contingent on prior performance. But more importantly, the system works because the incentive to produce is non-pecuniary.

Forms of government support and incentives tend to be either forms of direct subsidy, or indirect subsidy through tax policy. Support and incentives include:

- Grants
    - for research
    - for education
- Contracts
- Fellowships
    - for research
    - for education
- Loans
    - increased availability
    - lower interest
    - some "forgiveable"
- Provide Information Resources (e.g. MEDLARS for health research)
- Tax
    - option to "expense" research costs
    - accelerated depreciation for capital
    - 25% tax credit for qualifying projects
    - 10% tax credit for capital investments
    - deductions for charitable contributions to universities

The implications of various funding and incentives from a standpoint of economic efficiency is complex. An excellent treatment of the relative efficiency of subsidy or tax measures is presented by McFetridge (1977, p. 5). Some have commented that in some circumstances government involvement produces more distortion than it reduces (cf. Eads in McFetridge, 1977, p. 15 on government support of aircraft research).

4.2 Rewards, Incentives, and Funding for Culture

Many forms of intellectual property are considered an important part of a society's culture. These include music, painting, theatre, dance, poetry, and novels. The rewards and incentives for these are

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> of public recognition, and the second would introduce him to other potential patrons within the circle of the cardinal's friends. This was by far the more important step. For many years the newly arrived painter would work almost entirely for a limited group of clients, until at last a growing number of altar-pieces had firmly established his reputation with a wider public and he had sufficient income and prestige to set up on his own and accept commissions from a variety of sources. Once this had been achieved, he could view the death of his patron or a change in regime with some degree of equanimity.

The role of government funding has been mixed in the U.S. During the depression, in 1936, the WPA arts project had more than 40,000 artists on its roles. Representative Sirovich of New York hailed the activity as bringing culture to the masses in a way that no government had before (Larson, 1983, p. 1). Unfortunately, art was increasingly viewed as linked with subversion and boondoggle as the country came out of the depression. For the next twenty years one bill after another failed to produce substantial government support for culture. There were also those on the side of art who were concerned about government intrusion. Even with the passage of a bill that established the National Endowment for the Arts, support was still low. The $2.5 million in program funds appropriated in 1966 was not even a third of what the Ford Foundation had spent on ballet alone the previous year and tiny compared with the $85 million symphony orchestra program announced by the Ford Foundation in October (Larson, 1983, p. 230).

Thus, much of the support for culture comes from private foundations, charitable contributions of corporations, church contributions, and individual donations. For further documentation of these activities consult Miller (1970) on private endowment of education, Nielsen (1972) and Goulden (1971) on private foundation philanthropy, and Goldin (1969) on the support of public broadcasting.

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We should distinguish between for-profits and non-for-profits. Libraries, some of the abstracting and indexing services, the OCLC (Online Catalogue of the Library of Congress), are non-for-profits. With regard to incentives, these firms behave much more like scientists as described in 4.1. As Taylor (1984a) noted, these tend to be people dedicated to performing a socially valuable service.

Almost by definition, for-profits operate with pecuniary incentives. Internally, a major task of management is to devise ways to distribute the incentives to maximize output. Some segments of the firm respond to pecuniary incentives more than others, for example, marketing and sales forces have been traditionally targeted for varying compensation keyed to sales. In attempting to accelerate the rate of production, incentives keyed to meeting deadlines have been sucessful. However, this is not universal, as some production of intellectual property depends on professionals with temperments unsuitable to such coarse persuasion.

One of the most powerful tools for generating intellectual property, particularly invention, is equity. Members of a firm that hold sizable equity positions in the firm can be literally worth millions overnight in the right circumstances. Recall, under the risk discussion, that smaller firms tend to be less risk averse than larger firms. One major reason is the potential for enormous gain if the stock price is bid up quickly.

If property rights cannot be obtained or protected, the firm must still be able to appropriate a return on its investment. Sometimes this is achieved by being first. If the new product or service is very attractive, and if it takes some time to imitate, the firm can appropriate its investment before others compete away the return. Also, sometimes it

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reluctant to be sued for antitrust infringement because they are liable for trebal damages. The current administration has sought to reduce these concerns and change the antitrust law to encourage more joint development (cf. Gellhorn, Antitrust Law and Economics, 1981).

In the publishing field, Crew (1984) discusses the efficiency of different forms of contracts between author and publisher regarding payment. The five types of contracts are:

- Standard Royalty -- publisher pays author a percentage based on sales, perhaps with a sliding scale
- Profit Sharing -- author receives royalties based on publisher's profits on the book
- Cost Sharing -- some of the costs of production are incurred by the author
- Author's Fixed Fee -- fixed fee paid by the author to the publisher
- Publisher's Fixed Fee - fixed fee paid by the publisher to the author

In particular circumstances, contracts other than the standard royalty form of payment are superior in establishing a fair contract between author and publisher.

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extent efficiency is increased.

The economic function of property rights was recognized by A. T. Hadley in An Account of the Relations between Private Property and Public Welfare (in Cross, 1981, p. 37). Hadley traces the historical development of property rights and demonstrated that changes in economic structure, such as from hunting to agrarian societies, were accompanied in changes in the property rights that were held.

Dutton (1984) documents the historical development of the patent system in Europe. He states that patent rights were typically justified by four arguments: the natural-law thesis, the reward-by-monopoly thesis, the monopoly-profit thesis, and the exchange-for-secrets thesis. The gradual change in emphasis from the natural right thesis to the economic efficiency thesis occurred over a period from 1790 to 1860. In 1791, French patent law enshrined the belief in natural property rights in invention -- that the use without some form of compensation amounted to theft since the property was personal and exclusive. By the patent reform campaign of the 1820s in England, J. R. McCulloch referred to both natural rights and the increase of the level of inventive activity that occurred. But even at that time few others spoke of natural rights. "When the Westminster Review brusquely announced that 'to talk of the natural rights of an inventor is to talk nonsense', it was condemning an idea already widely discredited" (Dutton, 1984, p. 18).

In 1924, Commons (in Dugger, 1980, p. 47) said of "modern" property rights, "[t]hey protect the individual in his pursuit of rightful economic opportunity by enveloping him in property rights enforced by state sovereignty." "Natural rights of man are a myth, even though the myth once helped free man from the divine right of kings ... such rights

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it was not to provide additional jobs for performers (U.S. Congress Judiciary Hearings, 1979, p. 664). But the question returns to the appropriability of the value-added by the performing artist. Is the provision of copyright for the author of a song sufficient to provide full appropriability by the artist? Can the producer fully appropriate the performing artist's contribution and pass that along to the artist? In the hearings, it was noted that a few of the performing artists made most of the income and that royalties would only increase their wealth and not that of the "struggling" performers. But we have progressive income taxation to handle our concerns about excess distributions of wealth. So the issue for performing artists, and any other contributor to intellectual property through "adding value" remains open.

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segments of the industry seriously concentrating? To what extent can and should property rights be extended to those who add value to a basic piece of information?

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

A-1

Besen, Stanley M., Manning, Willard G., Jr., and Mitchell, Bridger M. (1978). "Copyright Liability for Cable Television: Compulsory Licensing and the Coase Theorem," The Journal of Law & Economics, vol. 21, no. 1, April, pp. 67-95.

Besen, Stanley M. (1984). The Effect of Reproduction Technology on Intellectual Property. Cambridge, MA: MIT Research Program on Communications Policy, March 22.

Bobbitt, Philip C. (1974). "Cable Television and Copyright Royalties," The Yale Law Journal, vol. 83, no. 3, January, pp. 554-578.

Boulding, Kenneth E. (1971). "The Economics of Knowledge and the Knowledge of Economics" in Economics of Information and Knowledge (edited by D. M. Lamberton). Baltimore: Penguin Books, Ltd..

Bowman, Ward S., Jr. (1973). Patent and Antitrust Law: A Legal and Economic Appraisal. Chicago: The University of Chicago Press.

Branscomb, Lewis M. (1983). "Improving R&D Productivity: The Federal Role," Science, vol. 222, October, pp. 133-135.

Braunstein, Yale M. (1975). An Economic Rationale for Page and Submission Charges by Academic Journals. New York: New York University Department of Economics, Center for Applied Economics, August.

Braunstein, Yale M. (1976). "Information as a Commodity," AAAS Meetings [Boston], February.

Braunstein, Yale M. (1976). "Public-Policy and Research on Economics in Information-Transfer," Proceedings of the American Society for Information Science, vol. 13, pp. 7-.

Braunstein, Yale M. (1979). "Costs and Benefits of Library Information: The User Point of View," Library Trends, vol. 28, no. 1, Summer, pp. 79-87.

Braunstein, Yale M. (1981). "The Functioning of Information Markets" in Issues in Information Policy (directed by Jane H. Yurow, edited by Helen A. Shaw). Washington, D.C.: U.S. Department of Commerce, National Telecom. & Info. Administration, February, pp. 57-74.

Braunstein, Yale (1981). "Information as a Commodity: Public Policy Issues and Recent Research" in Information Services: Economics, Management, and Technology (edited by Robert M. Mason and John E. Creps, Jr.). Boulder, CO: Westview Press.

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

A-3

Cross, Melvin L. and Ekelund, Robert B., Jr. (1981). "A. T. Hadley: The American Invention of the Economics of Property Rights and Public Goods," *Review of Social Economy*, pp. 37-50.

Cuadra, Carlos A. (1980). "The Role of the Private Sector in the Development and Improvement of Library and Information Services," *Library Quarterly*, vol. 50, no. 1, January, pp. 94-111.

Dertouzos, James N. and Wildman, Steven S. (1981). "A Study of Economic Issues in the Recording Industry" in *Copyright Issues: Cable Television and Performance Rights* (Serial No. 28). Washington, DC: U.S. Congress, House Committee on the Judiciary, Subcommittee on Courts, August, pp. 699-778.

Dugger, William M. (1980). "Property Rights, Law, and John R. Commons," *Review of Social Economy*, pp. 40-53.

Dutton, Harold I. (1984). *The Patent System and Inventive Activity during the Industrial Revolution: 1850-1852*. Manchester, U.K.: Manchester University Press.

Economic Council of Canada (1971). *Report on Intellectual and Industrial Property*. Halifax: Economic Council of Canada.

Feinman, Stephen (1981). "Regulation of STI Industry: A Historical Basis and Some Possibilities" in *Information Services: Economics, Management, and Technology* (edited by Robert M. Mason and John E. Creps, Jr.). Boulder, CO: Westview Press.

Ferris, Charles D. (1982). "Testimony of Charles D. Ferris, Prior Chairman of the Federal Communications Commission" in *Copyright/Cable Television* (Part 1, Serial No. 44). Washington, DC: U.S. Congress, House Committee on the Judiciary, Subcommittee on Courts, pp. 874-883.

Flowerdew, Anthony J. (1981). "The Government's Role in Providing Information: A British Academic's View" in *Information Services: Economics, Management, and Technology* (edited by Robert M. Mason and John E. Creps, Jr.). Boulder, CO: Westview Press.

Frazier, Donald (1985). "Piracy Study: 50% of Software Copied Illegally," *PC Week*, vol. 2, no. 3, January 22, p. 1+.

Gaston, Jerry (1978). *The Reward System in British and American Science*. New York: John Wiley & Sons, Inc..

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

A-5

Keiser, Norman F. (1965). Economics: Analysis and Policy. New York: John Wiley & Scns, Inc..

King, Donald W. (1977). Scientific and Technical Information: Current Issues Concerning This Essential National Resource. Commerce Technical Advisory Board, Jan. 6.

King, Donald W. and McDonald, Dennis D. (1980). Federal and Non-Federal Relationships in Providing Scientific and Technical Information: Policies, Arrangements, Flow of Funds and User Charges. Rockville, MD: King Research, Inc., March.

King, Donald W., McDonald, Dennis C., and Roderer, Nancy K. (1981). Scientific Journals in the United States: Their Production, Use, and Economics. Stroudsburg, PA: Hutchinson Ross Publications.

King, William R. and Zaltman, Gerald, (eds.) (1979). Marketing Scientific and Technical Information. Boulder, CO: Westview Press.

Kwon, Young K. (1982). "Private versus Public Production of Information," Journal of Economic Behavior & Organization, vol. 3, pp. 345-356.

Ladd, David (1982). "Statement of David Ladd, Register of Copyrights and Assistant Librarian of Congress for Copyright Services" in Copyright/Cable Television (Part 1, Serial No. 44). Washington, DC: U.S. Congress, House Committee on the Judiciary, Subcommittee on Courts, pp. 900-981.

Larson, Erik (1984). "Interactive Computer Services Become New Literary Medium," The Wall Street Journal, November 2, p. 31.

Larson, Gary O. (1983). The Reluctant Patron: The United States Government and the Arts, 1943-1965. Philadelphia: University of Pennsylvania Press.

Levine, Faye (1976). The Culture Barons. New York: Thomas Y. Crowell Company.

Levitan, Karen B. (1980). "Needed Research in the Economics of Information Resources," Proceedings of the American Society for Information Science, vol. 17, p. 344.

Levitan, Karen B. (1982). "Information Resources as "Goods" in the Life Cycle of Information Production," Journal of the American Society for Information Science, vol. 33, no. 1, January, pp. 44-54.

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

A-7

McGonagle, John J., Jr. (1982). *Business Agreements: A Complete Guide to Oral and Written Contracts*. Radnor, PA: Chilton Book Company.

Meade, J. E. (1952). "External Economies and Diseconomies in a Competitive Situation," *The Economic Journal*, vol. 62, March, pp. 54-67.

Meyerhoff, Howard A. (1966). "Statement of Prof. Howard A. Meyerhoff, Director and President, Committee to Investigate Copyright Problems Affecting Communication in Science and Education" in *Copyright Law Revision* (Part 3, Serial No. 8). Washington, DC: U.S. Congress, House Committee on the Judiciary, Subcommittee on Courts, pp. 1470-1477.

Miller, Howard S. (1970). *Dollars for Research: Science and Its Patrons in Nineteenth-Century America*. Seattle: University of Washington Press.

Minasian, Jora R. (1969). "The Political Economy of Broadcasting in the 1920's," *The University of Chicago Law School*, vol. 12, no. 2, October, pp. 391-402.

National Academy of Sciences (1969). *Scientific and Technical Communication: A Pressing National Problem and Recommendations for Its Solution* (Committee on Scientific and Technical Communication). Washington, DC: National Academy of Sciences.

National Commission on Libraries and Information Science (1976). *Evaluation of the Effectiveness of Federal Funding of Public Libraries*. Washington, DC: National Commission on Libraries and Information Science, December.

National Commission on Libaries and Information Science (1982). *Public Sector / Private Sector Interaction in Providing Information Services*. Washington, DC: National Commission on Libaries and Information Science, February 1.

Nielsen, Waldemar A. (1972). *The Big Foundations*. New York: Columbia University Press.

Nordhaus, William D. (1969). *Invention, Growth, and Welfare: A Theoretical Treatment of Technological Change*. Cambridge, MA: The MIT Press.

Nordhaus, William D. (1985). ""Private Discussion with William D. Nordhaus"," *MIT Center for Policy Alternatives* [Cambridge, MA], February 6.

O'Brien, Rita Cruise and Helleiner, G. K. (1980). "The Political Economy of Information in a Changing International Economic Order," *International Organization*, vol. 34, no. 1,

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

A-9

Priest, W. Curtiss and Ashford, Nicholas A. (1982). "Valuing Human Disease, Injury and Death" in Analyzing the Benefits of Health, Safety, and Environmental Regulations. Cambridge, MA: MIT Center for Policy Alternatives, September, pp. 9-1/9-92.

Priest, W. Curtiss (1984). "Characteristics of Information in Commerce and Transactions" (Working Paper). Cambridge, MA: MIT Center for Policy Alternatives, October 25.

Priest, W. Curtiss (1984). "Development of Economic Guidelines and Alternative Options for Public Investment and Disinvestment Decisions in Scientific and Technical Information" (Working Paper). Cambridge, MA: MIT Center for Policy Alternatives, March 15.

Priest, W. Curtiss and Kahin, Brian (1984). "Economics of Copyright" (Working Paper). Cambridge, MA: MIT Center for Policy Alternatives, November 5.

Priest, W. Curtiss (1984). "Political Economics of Property" (Working Paper). Cambridge, MA: MIT Center for Policy Alternatives, October 10.

Reagan, Michael D. (1969). Science and the Federal Patron. New York: Oxford University Press.

Reece, John E. (1981). Incentives to Work for Engineers and Scientists. Cambridge, MA: MIT Sloan School of Management.

Rosenberg, V. (1982). "National Information Policies" in Annual Review of Information Science and Technology. Knowledge Industry Publications, Inc., vol. 17, pp. 3-32.

Rubin, Michael Rogers (1983). Information Economics and Policy in the United States. Littleton, CO: Libraries Unlimited, Inc..

Samuelson, Paul A. (1973). Economics (Ninth Edition). New York: McGraw-Hill Book Company.

Sandler, Todd M., Loehr, William, and Cauley, Jon T. (1978). The Political Economy of Public Goods and International Cooperation. Denver: University of Denver.

Scherer, F. M. (1977). The Economic Effects of Compulsory Patent Licensing. New York: New York University.

Schmookler, Jacob (1966). Invention and Economic Growth. Cambridge, MA: Harvard University Press.

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

A-11

Taylor, Robert S. (1985). "Information Values in Decision Contexts," Information Management Review, vol. 1, no. 1, Spring.

Taylor, Robert S. (1985). Value Added Processes in Information Systems (in press). Norwood, NJ: Ablex Publishing Company.

Temin, Christine (1985). "Fundraiser for the Arts Has Key to the Boardrooms," The Boston Globe [Boston], February 9, p. 21.

Thomas, Sari, (ed) (1982). Film/Culture: Explorations of Cinema in its Social Context. Metuchen, NJ: The Scarecrow Press, Inc..

Torrence, George W. (1967). The Motivation and Measurement of Performance. Washington, DC: BNA Books.

Toulmin, H. A., Jr. (1939). Patents and the Public Interest. New York: Harper & Brothers Publishers.

U.S. Congress, House Committee on the Judiciary, Subcommittee on Courts (1979). "Statement of National Broadcasting Company, Inc." in Copyright/Cable Television (Part 1, Serial No. 44). Washington, DC: U.S. Congress, House Committee on the Judiciary, Subcommittee on Courts.

U.S. Library of Congress Network Advisory Committee (1984). Public/Private Sector Interactions: The Implications for Networking. Washington, DC: U.S. Library of Congress Network Advisory Committee.

U.S. National Commission on New Technological Uses of Copyrighted Works (1979). Final Report of the National Commission on New Technological Uses of Copyrighted Works (CONTU Report). Washington, DC: U.S. National Commission on New Technological Uses of Copyrighted Works.

U.S. National Commission on Libraries and Information Science (1982). Public Sector/Private Sector Interaction in Providing Information Services. Washington, DC: U.S. National Commission on Libraries and Information Science, February.

Office of Management and Budget (1983). "OMB Circular A-76," Office of Management and Budget [Washington, DC], August 4.

Valenti, Jack (1979). "Testimony of Jack Valenti, President, Motion Picture Association of America" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28). Washington, DC: U.S. Congress, House Committee on the Judiciary, Subcommittee on Courts, pp. 42-46.

The Character of Information

Extended

Bibliography

1. Bibliography with Reference Numbers
2. Author Listing
3. Subject Index

Dr. W. Curtiss Priest
February 10, 1985

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

b-1

SES78CLFC Besen, Stanley M., Manning, Willard G., Jr., and Mitchell, Bridger M., "Copyright Liability for Cable Television: Compulsory Licensing and the Coase Theorem," *The Journal of Law & Economics*, vol. 21, no. 1, April 1978, pp. 67-95.

IBESES84ERTO Besen, Stanley M., *The Effect of Reproduction Technology on Intellectual Property*. Cambridge, MA: MIT Research Program on Communications Policy, March 22, 1984.

IBOBBP74CTAC Bobbitt, Philip C., "Cable Television and Copyright Royalties," *The Yale Law Journal*, vol. 83, no. 3, January 1974, pp. 554-578.

IBOULK71EKAK Boulding, Kenneth E., "The Economics of Knowledge and the Knowledge of Economics" in *Economics of Information and Knowledge* (edited by D. M. Lamberton). Baltimore: Penguin Books, Ltd., 1971.

IBOWMW73PAAL Bowman, Ward S., Jr., *Patent and Antitrust Law: A Legal and Economic Appraisal*. Chicago: The University of Chicago Press, 1973.

IBRANL83IRDP Branscomb, Lewis M., "Improving R&D Productivity: The Federal Role," *Science*, vol. 222, October 1983, pp. 133-135.

RAUY75ERFP Braunstein, Yale M., *An Economic Rationale for Page and Submission Charges by Academic Journals*. New York: New York University Department of Economics, Center for Applied Economics, August 1975.

IBRAUY76IAAC Braunstein, Yale M., "Information as a Commodity," *AAAS Meetings* [Boston], February 1976.

IBRAUY76PPAR Braunstein, Yale M., "Public-Policy and Research on Economics in Information-Transfer," *Proceedings of the American Society for Information Science*, vol. 13, 1976, pp. 7-.

IBRAUY79CABL Braunstein, Yale M., "Costs and Benefits of Library Information: The User Point of View," *Library Trends*, vol. 28, no. 1, Summer 1979, pp. 79-87.

IBRAUY81FIMI Braunstein, Yale M., "The Functioning of Information Markets" in *Issues in Information Policy* (directed by Jane H. Yurow, edited by Helen A. Shaw). Washington, D.C.: U.S. Department of Commerce, National Telecom. & Info. Administration, February 1981, pp. 57-74.

IBRAUY81IAAC Braunstein, Yale, "Information as a Commodity: Public Policy Issues and Recent Research" in *Information Services: Economics, Management, and Technology* (edited by Robert M. Mason and John E. Creps, Jr.). Boulder, CO: Westview Press, 1981.

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

b-3

ROSM81ATHT Cross, Melvin L. and Ekelund, Robert B., Jr., "A. T. Hadley: The American Invention of the Economics of Property Rights and Public Goods," *Review of Social Economy*, 1981, pp. 37-50.

ICUADC80RPSI Cuadra, Carlos A., "The Role of the Private Sector in the Development and Improvement of Library and Information Services," *Library Quarterly*, vol. 50, no. 1, January 1980, pp. 94-111.

IDERTJ81SEII Dertouzos, James N. and Wildman, Steven S., "A Study of Economic Issues in the Recording Industry" in *Copyright Issues: Cable Television and Performance Rights* (Serial No. 28). Washington, DC: U.S. Congress, House Committee on the Judiciary, Subcommittee on Courts, August 1981, pp. 699-778.

IDUGGW80PRLA Dugger, William M., "Property Rights, Law, and John R. Commons," *Review of Social Economy*, 1980, pp. 40-53.

IDUTTH84PSAI Dutton, Harold I., *The Patent System and Inventive Activity during the Industrial Revolution: 1850-1852*. Manchester, U.K.: Manchester University Press, 1984.

IECOCC71ROIA Economic Council of Canada, *Report on Intellectual and Industrial Property*. Halifax: Economic Council of Canada, 1971.

IFEINS81RSIA Feinman, Stephen, "Regulation of STI Industry: A Historical Basis and Some Possibilities" in *Information Services: Economics, Management, and Technology* (edited by Robert M. Mason and John E. Creps, Jr.). Boulder, CO: Westview Press, 1981.

IFERRC82TCDF Ferris, Charles D., "Testimony of Charles D. Ferris, Prior Chairman of the Federal Communications Commission" in *Copyright/Cable Television* (Part 1, Serial No. 44). Washington, DC: U.S. Congress, House Committee on the Judiciary, Subcommittee on Courts, 1982, pp. 874-883.

IFLOWA81GSRI Flowerdew, Anthony J., "The Government's Role in Providing Information: A British Academic's View" in *Information Services: Economics, Management, and Technology* (edited by Robert M. Mason and John E. Creps, Jr.). Boulder, CO: Westview Press, 1981.

IFRAZD85PS5S Frazier, Donald, "Piracy Study: 50% of Software Copied Illegally," *PC Week*, vol. 2, no. 3, January 22, 1985, p. 1+.

IGASTJ78RSIB Gaston, Jerry, *The Reward System in British and American Science*. New York: John Wiley & Sons, Inc., 1978.

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

6-5

Policy Studies, February 1984.

IKEISN65EAAP Keiser, Norman F., *Economics: Analysis and Policy*. New York: John Wiley & Sons, Inc., 1965.

IKINGD77SATI King, Donald W., *Scientific and Technical Information: Current Issues Concerning This Essential National Resource*. Commerce Technical Advisory Board, Jan. 6, 1977.

IKINGD80FANF King, Donald W. and McDonald, Dennis D., *Federal and Non-Federal Relationships in Providing Scientific and Technical Information: Policies, Arrangements, Flow of Funds and User Charges*. Rockville, MD: King Research, Inc., March 1980.

IKINGD81SJIU King, Donald W., McDonald, Dennis C., and Roderer, Nancy K., *Scientific Journals in the United States: Their Production, Use, and Economics*. Stroudsburg, PA: Hutchinson Ross Publications, 1981.

IKINGW79MSAT King, William R. and Zaltman, Gerald, (eds.), *Marketing Scientific and Technical Information*. Boulder, CO: Westview Press, 1979.

IKWONY82PVPP Kwon, Young K., "Private versus Public Production of Information," *Journal of Economic Behavior & Organization*, vol. 3, 1982, pp. 345-356.

ILADDD82SDLR Ladd, David, "Statement of David Ladd, Register of Copyrights and Assistant Librarian of Congress for Copyright Services" in *Copyright/Cable Television* (Part 1, Serial No. 44). Washington, DC: U.S. Congress, House Committee on the Judiciary, Subcommittee on Courts, 1982, pp. 900-981.

ILARSE84ICSB Larson, Erik, "Interactive Computer Services Become New Literary Medium," *The Wall Street Journal*, November 2, 1984, p. 31.

ILARSG83RPTU Larson, Gary O., *The Reluctant Patron: The United States Government and the Arts, 1943-1965*. Philadelphia: University of Pennsylvania Press, 1983.

ILEVIF76CB•• Levine, Faye, *The Culture Barons*. New York: Thomas Y. Crowell Company, 1976.

ILEVIK80NRIE Levitan, Karen B., "Needed Research in the Economics of Information Resources," *Proceedings of the American Society for Information Science*, vol. 17, 1980, p. 344.

ILEVIK82IRAG Levitan, Karen B., "Information Resources as "Goods" in the Life Cycle of Information Production," *Journal of the American Society for Information Science*, vol. 33, no. 1, January 1982, pp. 44-54.

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

6-7

:GOJ82BAAC McGonagle, John J., Jr., Business Agreements: A Complete Guide to Oral and Written Contracts. Radnor, PA: Chilton Book Company, 1982.

IMEADJ52EEAD Meade, J. E., "External Economies and Diseconomies in a Competitive Situation," The Economic Journal, vol. 62, March 1952, pp. 54-67.

IMEYEH66SPHA Meyerhoff, Howard A., "Statement of Prof. Howard A. Meyerhoff, Director and President, Committee to Investigate Copyright Problems Affecting Communication in Science and Education" in Copyright Law Revision (Part 3, Serial No. 8). Washington, DC: U.S. Congress, House Committee on the Judiciary, Subcommittee on Courts, 1966, pp. 1470-1477.

IMILLH70DFRS Miller, Howard S., Dollars for Research: Science and Its Patrons in Nineteenth-Century America. Seattle: University of Washington Press, 1970.

IMINAJ69PEBI Minasian, Jora R., "The Political Economy of Broadcasting in the 1920's," The University of Chicago Law School, vol. 12, no. 2, October 1969, pp. 391-402.

INATAS69SATC National Academy of Sciences, Scientific and Technical Communication: A Pressing National Problem and Recommendations for Its Solution (Committee on Scientific and Technical Communication). Washington, DC: National Academy of Sciences, 1969.

INATCO76EEFF National Commission on Libraries and Information Science, Evaluation of the Effectiveness of Federal Funding of Public Libraries. Washington, DC: National Commission on Libraries and Information Science, December 1976.

INATCO82PSPS National Commission on Libaries and Information Science, Public Sector / Private Sector Interaction in Providing Information Services. Washington, DC: National Commission on Libaries and Information Science, February 1, 1982.

INIELW72BF** Nielsen, Waldemar A., The Big Foundations. New York: Columbia University Press, 1972.

INORDW69IGAW Nordhaus, William D., Invention, Growth, and Welfare: A Theoretical Treatment of Technological Change. Cambridge, MA: The MIT Press, 1969.

INORDW85PDWW Nordhaus, William D., ""Private Discussion with William D. Nordhaus"," MIT Center for Policy Alternatives [Cambridge, MA], February 6, 1985.

O'BRR80PEII O'Brien, Rita Cruise and Helleiner, G. K., "The Political Economy of Information in a Changing International Economic Order," International Organization, vol. 34, no. 1, Winter

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

6-9

9-1/9-92.

IPRIEW84CIIC Priest, W. Curtiss, "Characteristics of Information in Commerce and Transactions" (Working Paper). Cambridge, MA: MIT Center for Policy Alternatives, October 25, 1984.

IPRIEW84DEGA Priest, W. Curtiss, "Development of Economic Guidelines and Alternative Options for Public Investment and Disinvestment Decisions in Scientific and Technical Information" (Working Paper). Cambridge, MA: MIT Center for Policy Alternatives, March 15, 1984.

IPRIEW84ECWP Priest, W. Curtiss and Kahin, Brian, "Economics of Copyright" (Working Paper). Cambridge, MA: MIT Center for Policy Alternatives, November 5, 1984.

IPRIEW84PEPW Priest, W. Curtiss, "Political Economics of Property" (Working Paper). Cambridge, MA: MIT Center for Policy Alternatives, October 10, 1984.

IREAGM69SAFP Reagan, Michael D., *Science and the Federal Patron*. New York: Oxford University Press, 1969.

IREECJ81ITWF Reece, John E., *Incentives to Work for Engineers and Scientists*. Cambridge, MA: MIT Sloan School of Management, 1981.

OSEV82NIP7 Rosenberg, V., "National Information Policies" in *Annual Review of Information Science and Technology*. Knowledge Industry Publications, Inc., vol. 17, 1982, pp. 3-32.

IRUBIM83IEAP Rubin, Michael Rogers, *Information Economics and Policy in the United States*. Littleton, CO: Libraries Unlimited, Inc., 1983.

ISAMUP73ENE* Samuelson, Paul A., *Economics* (Ninth Edition). New York: McGraw-Hill Book Company, 1973.

ISANDT78PEPG Sandler, Todd M., Loehr, William, and Cauley, Jon T., *The Political Economy of Public Goods and International Cooperation*. Denver: University of Denver, 1978.

ISCHEF77EECP Scherer, F. M., *The Economic Effects of Compulsory Patent Licensing*. New York: New York University, 1977.

ISCHMJ66IAEG Schmookler, Jacob, *Invention and Economic Growth*. Cambridge, MA: Harvard University Press, 1966.

ISCHOA81ESAE Schotter, A. and Braunstein, Y. M., "Economic Search - An Experimental-Study," *Economic Inquiry*, vol. 19, no. 1, 1981, pp. 1-25.

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

6 - 11

AYLR85VAPI	Taylor, Robert S., Value Added Processes in Information Systems (in press). Norwood, NJ: Ablex Publishing Company, 1985.
ITEMIC85FFAH	Temin, Christine, "Fundraiser for the Arts Has Key to the Boardrooms," The Boston Globe [Boston], February 9, 1985, p. 21.
ITHOMS82FCEC	Thomas, Sari, (ed), Film/Culture: Explorations of Cinema in its Social Context. Metuchen, NJ: The Scarecrow Press, Inc., 1982.
ITORRG67MAMP	Torrence, George W., The Motivation and Measurement of Performance. Washington, DC: BNA Books, 1967.
ITOULH39PAPI	Toulmin, H. A., Jr., Patents and the Public Interest. New York: Harper & Brothers Publishers, 1939.
IUSC*HC79SNB	U.S. Congress, House Committee on the Judiciary, Subcommittee on Courts, "Statement of National Broadcasting Company, Inc." in Copyright/Cable Television (Part 1, Serial No. 44). Washington, DC: U.S. Congress, House Committee on the Judiciary, Subcommittee on Courts, 1979.
IUSLC*84PPSI	U.S. Library of Congress Network Advisory Committee, Public/Private Sector Interactions: The Implications for Networking. Washington, DC: U.S. Library of Congress Network Advisory Committee, 1984.
IUSNC*79FRNC	U.S. National Commission on New Technological Uses of Copyrighted Works, Final Report of the National Commission on New Technological Uses of Copyrighted Works (CONTU Report). Washington, DC: U.S. National Commission on New Technological Uses of Copyrighted Works, 1979.
IUSNC*82PSPS	U.S. National Commission on Libraries and Information Science, Public Sector/Private Sector Interaction in Providing Information Services. Washington, DC: U.S. National Commission on Libraries and Information Science, February 1982.
IUSOMA83OCA7	Office of Management and Budget, "OMB Circular A-76," Office of Management and Budget [Washington, DC], August 4, 1983.
IVALEJ79TJVP	Valenti, Jack, "Testimony of Jack Valenti, President, Motion Picture Association of America" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28). Washington, DC: U.S. Congress, House Committee on the Judiciary, Subcommittee on Courts, 1979, pp. 42-46.
IVALEJ82PTCF	Valenti, Jack, "A Plea to the Congress for Equity: The Case for Fair and Open Competition in the Cable Television Marketplace, Instead of the Anti-Competitive Arena that

AUTHOR	IDENTITY	TITLE
Ackoff, Russell L.	IACKOR72CCAC	Choice, Communication and Conflict (On Purposeful Systems)
Adler, Reid G.	IADLER84BAAI	Biotechnology as an Intellectual Property
Alderson, Wroe	IALDEW65PAPT	Patents and Progress: The Sources and Impact of Advancing Technology
Aldrich, Robert F.	IALDRR81IIIP	Issues in Information Policy
Arrow, Kenneth J.	IARROK71EWAA	"Economic Welfare and the Allocation of Resources for Invention" in Economics of Information and Knowledge (edited by D. M. Lamberton)
Ashford, Nicholas A.	IPRIEW82VHDI	"Valuing Human Disease, Injury and Death" in Analyzing the Benefits of Health, Safety, and Environmental Regulations
Back, Frank E.	IBACKF68EAIT	Economics: An Introduction to Analysis and Policy
Baran, Paul A.	IBARAP57PEG*	The Political Economy of Growth
Bator, Francis M.	IBATOF58AMF*	The Anatomy of Market Failure
Baumgarten, Jon A.	IBAUMJ83WCSN	Will Copyright Survive the New Technologies
Baumol, William J.	IBAUMW75OOPG	On the Optimality of Public-Goods Pricing with Exclusion Devices
	IBAUMW76PFIT	Private Financing of Information-Transfer - Theory and Execution
	IBAUMW80MPAC	Manual of Pricing and Cost Determination for Organizations Engaged in Dissemination of Knowledge
Beardsley, George	IMANSE77SAPR	Social and Private Rates of Return from Industrial Innovations
Belair, Robert R.	IALDRR81IIIP	Issues in Information Policy
Bentley, J. Marvin	IBENTJ81PRAE	Property Rights and Economic Development
Besen, Stanley M.	IBESES78CLFC	Copyright Liability for Cable Television: Compulsory Licensing and the Coase Theorem
	IBESES84ERTO	The Effect of Reproduction Technology on Intellectual Property
Bobbitt, Philip C.	IBOBBP74CTAC	Cable Television and Copyright Royalties
Boulding, Kenneth E.	IBOULK71EKAK	"The Economics of Knowledge and the Knowledge of Economics" in Economics of Information and Knowledge (edited by D. M. Lamberton)
Bowman, Ward S., Jr.	IBOWMW73PAAL	Patent and Antitrust Law: A Legal and Economic Appraisal

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

2

AUTHOR	IDENTITY	TITLE
Cross, Melvin L.	ICROSM81ATHT	A. T. Hadley: The American Invention of the Economics of Property Rights and Public Goods
Cuadra, Carlos A.	ICUADC80RPSI	The Role of the Private Sector in the Development and Improvement of Library and Information Services
Dertouzos, James N.	IDERTJ81SEII	"A Study of Economic Issues in the Recording Industry" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)
Dugger, William M.	IDUGGW80PRLA	Property Rights, Law, and John R. Commons
Dutton, Harold I.	IDUTTH84PSAI	The Patent System and Inventive Activity during the Industrial Revolution: 1850-1852
Ekelund, Robert B., Jr.	ICROSM81ATHT	A. T. Hadley: The American Invention of the Economics of Property Rights and Public Goods
Emery, Fred E.	IACKOR72CCAC	Choice, Communication and Conflict (On Purposeful Systems)
Feinman, Stephen	IFEINS81RSIA	"Regulation of STI Industry: A Historical Basis and Some Possibilities" in Information Services: Economics, Management, and Technology (edited by Robert M. Mason and John E. Creps, Jr.)
Ferris, Charles D.	IFERRC82TCDF	"Testimony of Charles D. Ferris, Prior Chairman of the Federal Communications Commission" in Copyright/Cable Television (Part 1, Serial No. 44)
Flowerdew, Anthony J.	IFLOWA81GSRI	"The Government's Role in Providing Information: A British Academic's View" in Information Services: Economics, Management, and Technology (edited by Robert M. Mason and John E. Creps, Jr.)
Frazier, Donald	IFRAZD85PS5S	Piracy Study: 50% of Software Copied Illegally
Gaston, Jerry	IGASTJ78RSIB	The Reward System in British and American Science
Geller, Henry	IGELLH79RCNT	"Reply Comments of the National Telecommunications and Information Administration to FCC Docket 20988 and 21284" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)
Gellhorn, Ernest	IGELLE81ALAE	Antitrust Law and Economics: in a Nutshell
Goldin, Hyman H.	IGOLDH69FPB*	Financing Public Broadcasting
Gordon, Wendy J.	IGORDW82FUAM	Fair Use as Market Failure: A Structural and Economic Analysis of the Betamax Case and its Predecessors
Goulden, Joseph C.	IGOULJ71MGAE	The Money Givers: An Examination of the Myths and Realities of Foundation Philanthropy in America

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

4

AUTHOR	IDENTITY	TITLE
Larson, Gary O.	ILARSG83RPTU	1943-1965
Levine, Faye	ILEVIF76CB**	The Culture Barons
Levitan, Karen B.	ILEVIK80NRIE	Needed Research in the Economics of Information Resources
	ILEVIK82IRAG	Information Resources as "Goods" in the Life Cycle of Information Production
Lodwick, Lyle	ILODWL66SLLD	"Statement of Lyle Lodwick, Director of Marketing, Williams & Wilkins Co., Baltimore, MD" in Copyright Law Revision (Part 3, Serial No. 8)
Loehr, William	ISANDT78PEPG	The Political Economy of Public Goods and International Cooperation
Machlup, Fritz	IMACHF52PEMB	The Political Economy of Monopoly: Business, Labor and Government Policies
	IMACHF62PADK	The Production and Distribution of Knowledge in the United States
	IMACHF80KICD	Knowledge: Its Creation, Distribution, and Economic Significance, Volume I, Knowledge and Knowledge Production
	IMACHF84KICD	Knowledge: Its Creation, Distribution, and Economic Significance, Volume III, The Economics of Information and Human Capital
Mackaay, Ejan	IMACKE82EIAL	Economics of Information and Law
Manning, Willard G., Jr.	IBESES78CLFC	Copyright Liability for Cable Television: Compulsory Licensing and the Coase Theorem
Mansfield, Edwin	IMANSE77SAPR	Social and Private Rates of Return from Industrial Innovations
Manten, Arie A.	IMANTA83IPAS	Information Policy and Scientific Research
May, Lee	IMAY*L84LTPC	Law to Penalize Chip Pirates Signed
McDonald, Dennis C.	IKINGD81SJIU	Scientific Journals in the United States: Their Production, Use, and Economics
McDonald, Dennis D.	IKINGD80FANF	Federal and Non-Federal Relationships in Providing Scientific and Technical Information: Policies, Arrangements, Flow of Funds and User Charges
	IMCDOD82PSP7	"Public-Sector Private Sector Interaction in Information Services" in Annual Review of Information Science and Technology
	IMCDOD83CCSN	Copyright Can Survive the New Technologies
McFetridge, D. G.	IMCFED77GSSR	Government Support of Scientific Research and Development: An Economic Analysis
McGonagle, John J., Jr.*	IMCGOJ82BAAC	Business Agreements: A Complete Guide to Oral and Written Contracts

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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AUTHOR	IDENTITY	TITLE
Pogue, Thomas F.	IPOGUT78GAEC	Government and Economic Choice: An Introduction to Public Finance
Pool, Ithiel de Sola	IPOOLI80IPAT	Intellectual Property and Transborder Data Flows
	IPOOLI83TF**	Technologies of Freedom
Porat, Marc Uri	IPORAM77IEDA	The Information Economy: Definition and Measurement
	IPORAM77IENI	The Information Economy: National Income, Workforce, and Input-Output Accounts
Priest, W. Curtiss	IPRIEW72NAVR	The Need and Value of Restructuring Human Communication Systems (Doctoral Dissertation)
	IPRIEW82VHDI	"Valuing Human Disease, Injury and Death" in Analyzing the Benefits of Health, Safety, and Environmental Regulations
	IPRIEW84CIIC	"Characteristics of Information in Commerce and Transactions" (Working Paper)
	IPRIEW84DEGA	"Development of Economic Guidelines and Alternative Options for Public Investment and Disinvestment Decisions in Scientific and Technical Information" (Working Paper)
	IPRIEW84ECWP	"Economics of Copyright" (Working Paper)
	IPRIEW84PEPW	"Political Economics of Property" (Working Paper)
Raper, Diane	IHINDA76EIIA	"The Economics of Information" in Annual Review of Information Science and Technology
Rapoport, John	IMANSE77SAPR	Social and Private Rates of Return from Industrial Innovations
Reagan, Michael D.	IREAGM69SAFP	Science and the Federal Patron
Reece, John E.	IREECJ81ITWF	Incentives to Work for Engineers and Scientists
Roberston, Lawrence S.	IALDRR81IIIP	Issues in Information Policy
Roderer, Nancy K.	IKINGD81SJIU	Scientific Journals in the United States: Their Production, Use, and Economics
Romeo, Anthony	IMANSE77SAPR	Social and Private Rates of Return from Industrial Innovations
Rosenberg, V.	IROSEV82NIP7	"National Information Policies" in Annual Review of Information Science and Technology
Rubin, Michael Rogers	IRUBIM83IEAP	Information Economics and Policy in the United States
Samuelson, Paul A.	ISAMUP73ENE*	Economics (Ninth Edition)

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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AUTHOR	IDENTITY	TITLE
Taylor, Robert S.	ITAYLR85VAPI	Value Added Processes in Information Systems (in press)
Temin, Christine	ITEMIC85FFAH	Fundraiser for the Arts Has Key to the Boardrooms
Terpstra, Vern	IALDEW65PAPT	Patents and Progress: The Sources and Impact of Advancing Technology
Torrence, George W.	ITORRG67MAMP	The Motivation and Measurement of Performance
Toulmin, H. A., Jr.	ITOULH39PAPI	Patents and the Public Interest
Valenti, Jack	IVALEJ79TJVP	"Testimony of Jack Valenti, President, Motion Picture Association of America" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)
	IVALEJ82PTCF	"A Plea to the Congress for Equity: The Case for Fair and Open Competition in the Cable Television Marketplace, Instead of the Anti-Competitive Arena that Exists Today" in Copyright/Cable Television (Part 1, Serial No. 44)
Viner, Jacob	IVINEJ31CCAS	Cost Curves and Supply Curves
Vinken, P.	IVINKP82IEGA	Information Economy, Government and Society
Wagner, Samuel	IMANSE77SAPR	Social and Private Rates of Return from Industrial Innovations
Wheeler, Thomas E.	IWHEET82STEW	"Statement of Thomas E. Wheeler, President, National Cable Television Association" in Copyright/Cable Television (Part 1, Serial No. 44)
Wildavsky, Aaron B.	IALDRR81IIIP	Issues in Information Policy
Wildman, Steven S.	IDERTJ81SEII	"A Study of Economic Issues in the Recording Industry" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

/

KEYWORD	IDENTITY	TITLE
APPROPRIABILITY	IFRAZD85PS5S	Piracy Study: 50% of Software Copied Illegally
	IGORDW82FUAM	Fair Use as Market Failure: A Structural and Economic Analysis of the Betamax Case and its Predecessors
	IHALLK81ENI*	The Economic Nature of Information
	IMACHF84KICD	Knowledge: Its Creation, Distribution, and Economic Significance, Volume III, The Economics of Information and Human Capital
	IMANSE77SAPR	Social and Private Rates of Return from Industrial Innovations
	INORDW69IGAW	Invention, Growth, and Welfare: A Theoretical Treatment of Technological Change
	IO'BRR80PEII	The Political Economy of Information in a Changing International Economic Order
	IPRIEW84CIIC	"Characteristics of Information in Commerce and Transactions" (Working Paper)
	IPRIEW84DEGA	"Development of Economic Guidelines and Alternative Options for Public Investment and Disinvestment Decisions in Scientific and Technical Information" (Working Paper)
	IPRIEW84ECWP	"Economics of Copyright" (Working Paper)
	ISCHEF77EECP	The Economic Effects of Compulsory Patent Licensing
ART	IHASKF63PAP*	Patrons and Painters
	ILARSG83RPTU	The Reluctant Patron: The United States Government and the Arts, 1943-1965
	ITEMIC85FFAH	Fundraiser for the Arts Has Key to the Boardrooms
ASCAP	IPOOLI80IPAT	Intellectual Property and Transborder Data Flows
AUTHOR'S-FIXED-FEE	ICREWM84RCAE	Royalty Contracts: An Efficient Form of Contracting?
B-TO-V	IPRIEW82VHDI	"Valuing Human Disease, Injury and Death" in Analyzing the Benefits of Health, Safety, and Environmental Regulations
BALLET	ILEVIF76CB**	The Culture Barons
BIBLIOGRAPHY	ICHARR83TSIS	Technology Supported Information Systems: Selected References
	IREECJ81ITWF	Incentives to Work for Engineers and Scientists
BIOTECHNOLOGY	IADLER84BAAI	Biotechnology as an Intellectual Property

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
CABLE	IVALEJ79TJVP	Rights (Serial No. 28)
	IVALEJ82PTCF	"A Plea to the Congress for Equity: The Case for Fair and Open Competition in the Cable Television Marketplace, Instead of the Anti-Competitive Arena that Exists Today" in Copyright/Cable Television (Part 1, Serial No. 44)
	IWHEET82STEW	"Statement of Thomas E. Wheeler, President, National Cable Television Association" in Copyright/Cable Television (Part 1, Serial No. 44)
CARNEGIE-COMMISSION	IGOLDH69FPB*	Financing Public Broadcasting
CATV	IBOBBP74CTAC	Cable Television and Copyright Royalties
CHANNEL-THEORY	IKINGW79MSAT	Marketing Scientific and Technical Information
COASE-THEOREM	IBESES78CLFC	Copyright Liability for Cable Television: Compulsory Licensing and the Coase Theorem
	IMACKE82EIAL	Economics of Information and Law
CODED-INFORMATION	IPETHR83OPAD	On the Production and Distribution of Information
COLLECTIVE-BARGAINING	IECOCC71ROIA	Report on Intellectual and Industrial Property
COLLECTIVE-GOOD	IGORDW82FUAM	Fair Use as Market Failure: A Structural and Economic Analysis of the Betamax Case and its Predecessors
COMMON-LAW	IPEYTD81CIPR	"The Creation of Information: Property Rights and Subsidies" in Issues in Information Policy (directed by Jane Yurow, edited by Helen A. Shaw)
COMMON-LAW-DUTY	IHOMER84GMSA	"Getting the Message": Statutory Approaches to Electronic Information Delivery and the Duty of Carriage
COMMUNICATIONS-ACT	IGELLH79RCNT	"Reply Comments of the National Telecommunications and Information Administration to FCC Docket 20988 and 21284" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)
COMPRESSIBILITY	ICLEVH82IAAR	Information as a Resource
COMPULSORY-LICENSING	IBESES78CLFC	Copyright Liability for Cable Television: Compulsory Licensing and the Coase Theorem
	ILADDD82SDLR	"Statement of David Ladd, Register of Copyrights and Assistant Librarian of Congress for Copyright Services" in Copyright/Cable Television (Part 1, Serial No. 44)
	ITAYLC73EIPS	The Economic Impact of the Patent System
	ITOULH39PAPI	Patents and the Public Interest

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
COPYRIGHT	IECOCC71ROIA	Report on Intellectual and Industrial Property
	IFERRC82TCDF	"Testimony of Charles D. Ferris, Prior Chairman of the Federal Communications Commission" in Copyright/Cable Television (Part 1, Serial No. 44)
	IFRAZD85PS5S	Piracy Study: 50% of Software Copied Illegally
	IGILBM82IPRI	Intellectual Property Rights in High Technology Products and in Sensitive Business Information
	ILADDD82SDLR	"Statement of David Ladd, Register of Copyrights and Assistant Librarian of Congress for Copyright Services" in Copyright/Cable Television (Part 1, Serial No. 44)
	ILODWL66SLLD	"Statement of Lyle Lodwick, Director of Marketing, Williams & Wilkins Co., Baltimore, MD" in Copyright Law Revision (Part 3, Serial No. 8)
	IMCDOD83CCSN	Copyright Can Survive the New Technologies
	IMEYEH66SPHA	"Statement of Prof. Howard A. Meyerhoff, Director and President, Committee to Investigate Copyright Problems Affecting Communication in Science and Education" in Copyright Law Revision (Part 3, Serial No. 8)
	IPCW**85NSBI	Nipping the Software Buccaneers in the Bud
	IPEYTD81CIPR	"The Creation of Information: Property Rights and Subsidies" in Issues in Information Policy (directed by Jane Yurow, edited by Helen A. Shaw)
	IPLOME80CIPI	Copyright: Intellectual Property in the Information Age
	IPOOLI80IPAT	Intellectual Property and Transborder Data Flows
	IPRIEW84ECWP	"Economics of Copyright" (Working Paper)
	ISOLOR84CC**	Copyright Chaos
	IUSNC*79FRNC	Final Report of the National Commission on New Technological Uses of Copyrighted Works (CONTU Report)
	IVALEJ82PTCF	"A Plea to the Congress for Equity: The Case for Fair and Open Competition in the Cable Television Marketplace, Instead of the Anti-Competitive Arena that Exists Today" in Copyright/Cable Television (Part 1, Serial No. 44)
COPYRIGHT CLEARANCE CENTER	IMCDOD83CCSN	Copyright Can Survive the New Technologies
	IMEYEH66SPHA	"Statement of Prof. Howard A. Meyerhoff, Director and President,

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
DISCLOSURE	IGILBM82IPRI	Intellectual Property Rights in High Technology Products and in Sensitive Business Information
DISTRIBUTION	IBRAUY81FIMI	"The Functioning of Information Markets" in Issues in Information Policy (directed by Jane H. Yurow, edited by Helen A. Shaw)
	ICOOPM83EIIA	"The Economics of Information" in Annual Review of Information Science and Technology
	IFLOWA81GSRI	"The Government's Role in Providing Information: A British Academic's View" in Information Services: Economics, Management, and Technology (edited by Robert M. Mason and John E. Creps, Jr.)
	IGORDW82FUAM	Fair Use as Market Failure: A Structural and Economic Analysis of the Betamax Case and its Predecessors
	IHALLK81ENI*	The Economic Nature of Information
	IKEISN65EAAP	Economics: Analysis and Policy
	IMACKE82EIAL	Economics of Information and Law
	IPOGUT78GAEC	Government and Economic Choice: An Introduction to Public Finance
DIVERSITY	IBRAUY81FIMI	"The Functioning of Information Markets" in Issues in Information Policy (directed by Jane H. Yurow, edited by Helen A. Shaw)
DYNAMIC-INNOVATION	IALDEW65PAPT	Patents and Progress: The Sources and Impact of Advancing Technology
ECONOMIC-DEVELOPMENT	IBENTJ81PRAE	Property Rights and Economic Development
ECONOMIC-GROWTH	ISCHMJ66IAEG	Invention and Economic Growth
ECONOMIC-IMPACT	ILODWL66SLLD	"Statement of Lyle Lodwick, Director of Marketing, Williams & Wilkins Co., Baltimore, MD" in Copyright Law Revision (Part 3, Serial No. 8)
	IMINAJ69PEBI	The Political Economy of Broadcasting in the 1920's
ECONOMIC-POWER	ISCHWA80PAEP	Property and Economic Power
ECONOMICS-OF-FILM	ITHOMS82FCEC	Film/Culture: Explorations of Cinema in its Social Context
ECONOMICS-OF-INFORMATION	IARROK71EWAA	"Economic Welfare and the Allocation of Resources for Invention" in Economics of Information and Knowledge (edited by D. M. Lamberton)
	IBOULK71EKAK	"The Economics of Knowledge and the Knowledge of Economics" in Economics of Information and Knowledge (edited by D. M. Lamberton)
	IBOWMW73PAAL	Patent and Antitrust Law: A Legal and Economic Appraisal

AUTHOR	IDENTITY	TITLE
Taylor, Robert S.	ITAYLR85VAPI	Value Added Processes in Information Systems (in press)
Temin, Christine	ITEMIC85FFAH	Fundraiser for the Arts Has Key to the Boardrooms
Terpstra, Vern	IALDEW65PAPT	Patents and Progress: The Sources and Impact of Advancing Technology
Torrence, George W.	ITORRG67MAMP	The Motivation and Measurement of Performance
Toulmin, H. A., Jr.	ITOULH39PAPI	Patents and the Public Interest
Valenti, Jack	IVALEJ79TJVP	"Testimony of Jack Valenti, President, Motion Picture Association of America" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)
	IVALEJ82PTCF	"A Plea to the Congress for Equity: The Case for Fair and Open Competition in the Cable Television Marketplace, Instead of the Anti-Competitive Arena that Exists Today" in Copyright/Cable Television (Part 1, Serial No. 44)
Viner, Jacob	IVINEJ31CCAS	Cost Curves and Supply Curves
Vinken, P.	IVINKP82IEGA	Information Economy, Government and Society
Wagner, Samuel	IMANSE77SAPR	Social and Private Rates of Return from Industrial Innovations
Wheeler, Thomas E.	IWHEET82STEW	"Statement of Thomas E. Wheeler, President, National Cable Television Association" in Copyright/Cable Television (Part 1, Serial No. 44)
Wildavsky, Aaron B.	IALDRR81IIIP	Issues in Information Policy
Wildman, Steven S.	IDERTJ81SEII	"A Study of Economic Issues in the Recording Industry" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)

KEYWORD	IDENTITY	TITLE
ECONOMY-OF-SCALE	IBRAUY81FIMI	Policy (directed by Jane H. Yurow, edited by Helen A. Shaw)
	IDERTJ81SEII	"A Study of Economic Issues in the Recording Industry" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)
	ILEVIK82IRAG	Information Resources as "Goods" in the Life Cycle of Information Production
	IMACKE82EIAL	Economics of Information and Law
	INORDW69IGAW	Invention, Growth, and Welfare: A Theoretical Treatment of Technological Change
	IO'BRR80PEII	The Political Economy of Information in a Changing International Economic Order
	IPRIEW84CIIC	"Characteristics of Information in Commerce and Transactions" (Working Paper)
	IPRIEW84DEGA	"Development of Economic Guidelines and Alternative Options for Public Investment and Disinvestment Decisions in Scientific and Technical Information" (Working Paper)
	IPRIEW84ECWP	"Economics of Copyright" (Working Paper)
	ISAMUP73ENE*	Economics (Ninth Edition)
	ISINGN72PM**	Public Microeconomics
ECONOMY-OF-SCOPE	IBRAUY81FIMI	"The Functioning of Information Markets" in Issues in Information Policy (directed by Jane H. Yurow, edited by Helen A. Shaw)
	ILEVIK82IRAG	Information Resources as "Goods" in the Life Cycle of Information Production
EIES	ILARSE84ICSB	Interactive Computer Services Become New Literary Medium
EMPLOYEE-SHARED-RETURN	ITOULH39PAPI	Patents and the Public Interest
EMPLOYMENT	ILARSG83RPTU	The Reluctant Patron: The United States Government and the Arts, 1943-1965
	IMCFED77GSSR	Government Support of Scientific Research and Development: An Economic Analysis
	IUSC*HC79SNB	"Statement of National Broadcasting Company, Inc." in Copyright/Cable Television (Part 1, Serial No. 44)
ENTRY	IBRAUY81FIMI	"The Functioning of Information Markets" in Issues in Information

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
EXTERNALITY	IMEADJ52EEAD	External Economies and Diseconomies in a Competitive Situation
	INORDW69IGAW	Invention, Growth, and Welfare: A Theoretical Treatment of Technological Change
	IPIGOA32EW4E	The Economics of Welfare (4th edition)
	IPOGUT78GAEC	Government and Economic Choice: An Introduction to Public Finance
	IPRIEW84CIIC	"Characteristics of Information in Commerce and Transactions" (Working Paper)
	IPRIEW84DEGA	"Development of Economic Guidelines and Alternative Options for Public Investment and Disinvestment Decisions in Scientific and Technical Information" (Working Paper)
	IREAGM69SAFP	Science and the Federal Patron
	ISAMUP73ENE•	Economics (Ninth Edition)
	ISCITT54TCEE	Two Concepts of External Economics
	ISINGN72PM••	Public Microeconomics
	IVINEJ31CCAS	Cost Curves and Supply Curves
FAIR-USE	IBOBBP74CTAC	Cable Television and Copyright Royalties
	IGORDW82FUAM	Fair Use as Market Failure: A Structural and Economic Analysis of the Betamax Case and its Predecessors
	ILODWL66SLLD	"Statement of Lyle Lodwick, Director of Marketing, Williams & Wilkins Co., Baltimore, MD" in Copyright Law Revision (Part 3, Serial No. 8)
	IPEYTD81CIPR	"The Creation of Information: Property Rights and Subsidies" in Issues in Information Policy (directed by Jane Yurow, edited by Helen A. Shaw)
	IPLOME80CIPI	Copyright: Intellectual Property in the Information Age
FILM	ILEVIF76CB••	The Culture Barons
	ITHOMS82FCEC	Film/Culture: Explorations of Cinema in its Social Context
FILM-FINANCING	ITHOMS82FCEC	Film/Culture: Explorations of Cinema in its Social Context
FINANCIAL-ALTERNATIVE	IALDEW65PAPT	Patents and Progress: The Sources and Impact of Advancing Technology
	IARROK71EWAA	"Economic Welfare and the Allocation of Resources for Invention" in

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD                   IDENTITY      TITLE
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FINANCIAL-ALTERNATIVE     INORDW69IGAW  Change

                          IPEYTD81CIPR  "The Creation of Information: Property Rights and Subsidies"
                                        in Issues in Information Policy (directed by Jane Yurow, edited
                                        by Helen A. Shaw)

                          IPOGUT78GAEC  Government and Economic Choice: An Introduction to Public Finance

                          IPOOLI80IPAT  Intellectual Property and Transborder Data Flows

                          IPRIEW84ECWP  "Economics of Copyright" (Working Paper)

                          ITEMIC85FFAH  Fundraiser for the Arts Has Key to the Boardrooms

                          ITORRG67MAMP  The Motivation and Measurement of Performance

                          ITOULH39PAPI  Patents and the Public Interest

                          IUSNC*79FRNC  Final Report of the National Commission on New Technological Uses
                                        of Copyrighted Works (CONTU Report)

                          IUSOMA83OCA7  OMB Circular A-76

FINANCIAL-PRIZE           IECOCC71ROIA  Report on Intellectual and Industrial Property

FORTNIGHTLY               IBOBBP74CTAC  Cable Television and Copyright Royalties

FOUNDATION-PHILANTHROPY   IGOULJ71MGAE  The Money Givers: An Examination of the Myths and Realities of
                                        Foundation Philanthropy in America

                          INIELW72BF**  The Big Foundations

FREE-RIDER                IBESES78CLFC  Copyright Liability for Cable Television: Compulsory Licensing
                                        and the Coase Theorem

                          ICROSM81ATHT  A. T. Hadley: The American Invention of the Economics of
                                        Property Rights and Public Goods

                          IGORDW82FUAM  Fair Use as Market Failure: A Structural and Economic Analysis
                                        of the Betamax Case and its Predecessors

                          IMACHF84KICD  Knowledge: Its Creation, Distribution, and Economic Significance,
                                        Volume III, The Economics of Information and Human Capital

FREEDOM                   IDUGGW80PRLA  Property Rights, Law, and John R. Commons

GOVERNMENT-PROVISION      IBRAUY81FIMI  "The Functioning of Information Markets" in Issues in Information
                                        Policy (directed by Jane H. Yurow, edited by Helen A. Shaw)

                          ICOOPM83EIIA  "The Economics of Information" in Annual Review of Information
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PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
INDIVISIBILITY	1NORDW69IGAW	Invention, Growth, and Welfare: A Theoretical Treatment of Technological Change
	1O'BRR80PEII	The Political Economy of Information in a Changing International Economic Order
	1PETHWR83DPAD	On the Production and Distribution of Information
	1PRIEM84CIIC	"Characteristics of Information in Commerce and Transactions" (Working Paper)
	1PRIEM84DEGA	"Development of Economic Guidelines and Alternative Options for Public Investment and Disinvestment Decisions in Scientific and Technical Information" (Working Paper)
INFORMATION AS CO PRODUCER	1CLEVH82IAAR	Information as a Resource
	1PRIEM84CIIC	"Characteristics of Information in Commerce and Transactions" (Working Paper)
INFORMATION-ANALYSIS	1TAYLR84VAPI	Value-added Processes in Information Analysis
INFORMATION-AS-CO-PRODUCER	1PRIEM72NAVO	The Need and Value of Restructuring Human Communication Systems (Doctoral Dissertation)
	1READM65SATF	Science and the Federal Patron
INFORMATION-AS-COMMODITY	1ARROK71EWAT	"Economic Welfare and the Allocation of Resources for Invention" in Economics of Information and Knowledge (edited by D. M. Lamberton)
	1BRAUY78IAAC	Information as a Commodity
	1BRAUY81IAAC	"Information as a Commodity: Public Policy Issues and Recent Research" in Information Services: Economics, Management, and Technology (edited by Robert M. Mason and John E. Creps, Jr.)
	1COOPM83TEOI	"The Economics of Information" in Annual Review of Information Science and Technology
	1LEVIA82IRAG	Information Resources as "Goods" in the Life Cycle of Information Production
	1MACKE82EIAL	Economics of Information and Law
	1PRIEM84CIIC	"Characteristics of Information in Commerce and Transactions" (Working Paper)
	1PRIEM84DEGA	"Development of Economic Guidelines and Alternative Options for Public Investment and Disinvestment Decisions in Scientific

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
INFORMATION-ON-INFORMATION	IPRISM84CIIC	and Transactions" (Working Paper)
	IPRISM84DEGA	"Development of Economic Guidelines and Alternative Options for Public Investment and Disinvestment Decisions in Scientific and Technical Information" (Working Paper)
INFORMATION-OUTPUT	ITAYLR82IAPD	Information and Productivity: On Defining Information Output (I)
	ITAYLR84IAPD	Information and Productivity: On Defining Information Output (II)
INFORMATION-SECTOR	IBRAUY79IAAC	Information as a Commodity
	ICOOPM83SAFI	The Structure and Future of the Information Economy
	ICUADC80RPSI	The Role of the Private Sector in the Development and Improvement of Library and Information Services
	IMACHF62PADK	The Production and Distribution of Knowledge in the United States
	IPORAM77IEDA	The Information Economy: Definition and Measurement
	IPORAM77IENI	The Information Economy: National Income, Workforce, and Input-Output Accounts
	IRUBIM83IEAP	Information Economics and Policy in the United States
INFORMATION-SERVICES	ICUADC80RPSI	The Role of the Private Sector in the Development and Improvement of Library and Information Services
	IMACHF62PADK	The Production and Distribution of Knowledge in the United States
INFORMATION-SYSTEMS	ICHARR83TSIS	Technology Supported Information Systems: Selected References
	ITAYLR82VAPI	Value-Added Processes in the Information Life Cycle
	ITAYLR84VAPI	Value-added Processes in Document-Based Systems: Abstracting and Indexing Services
	ITAYLR85VAPI	Value Added Processes in Information Systems (in press)
INFORMATION-TECHNOLOGY	IBAUMJ83WCSN	Will Copyright Survive the New Technologies
	IBESES84ERTO	The Effect of Reproduction Technology on Intellectual Property
	ICHARR83TSIS	Technology Supported Information Systems: Selected References
	ILARSE84ICSB	Interactive Computer Services Become New Literary Medium
	IMAY*L84LTPC	Law to Penalize Chip Pirates Signed
	IMCDOD83CCSN	Copyright Can Survive the New Technologies

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
INTERNALLY-GENERATED	IHOLMW83IPAA	Intellectual Property and Antitrust Law
INTRINSIC-ETHICS	IPRIEW72NAVR	The Need and Value of Restructuring Human Communication Systems (Doctoral Dissertation)
	IPRIEW84CIIC	"Characteristics of Information in Commerce and Transactions" (Working Paper)
INTRINSIC-WELFARE	ICLEVH82IAAR	Information as a Resource
	IPRIEW84CIIC	"Characteristics of Information in Commerce and Transactions" (Working Paper)
INVENTION	ISCHMJ66IAEG	Invention and Economic Growth
INVESTMENT/REPRODUCTION	IBRAUY81FIMI	"The Functioning of Information Markets" in Issues in Information Policy (directed by Jane H. Yurow, edited by Helen A. Shaw)
	IPETHR83OPAD	On the Production and Distribution of Information
	IPRIEW84CIIC	"Characteristics of Information in Commerce and Transactions" (Working Paper)
	IPRIEW84ECWP	"Economics of Copyright" (Working Paper)
JOINTNESS-OF-SUPPLY	IGORDW82FUAM	Fair Use as Market Failure: A Structural and Economic Analysis of the Betamax Case and its Predecessors
JOURNAL-SURCHARGE	IMCDOD83CCSN	Copyright Can Survive the New Technologies
KAMIEN-AND-SCHWARTZ	ISCHEF77EECP	The Economic Effects of Compulsory Patent Licensing
KITTI,-CAROLE	ISCHEF77EECP	The Economic Effects of Compulsory Patent Licensing
KNOWLEDGE-PRODUCTION	INORDW69IGAW	Invention, Growth, and Welfare: A Theoretical Treatment of Technological Change
LABOR-LEGISLATION	IUSC*HC79SNB	"Statement of National Broadcasting Company, Inc." in Copyright/Cable Television (Part 1, Serial No. 44)
LEGISLATION	IMAY*L84LTPC	Law to Penalize Chip Pirates Signed
LIBERTY	IDUGGW80PRLA	Property Rights, Law, and John R. Commons
LIBRARY-SERVICE	ICASPC81EPMA	"Economic Pricing Models and Their Application to Library Services" in Information Services: Economics, Management, and Technology (edited by Robert M. Mason and John E. Creps, Jr.)
	ICOOPM83EIIA	"The Economics of Information" in Annual Review of Information

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
MARGINAL-COST-PRICING	ISAMUP73ENE*	Economics (Ninth Edition)
	ISINGN72PM**	Public Microeconomics
MARKET-STRUCTURE	IBRAUY81FIMI	"The Functioning of Information Markets" in Issues in Information Policy (directed by Jane H. Yurow, edited by Helen A. Shaw)
	ICOOPM83SAFI	The Structure and Future of the Information Economy
	IDERTJ81SEII	"A Study of Economic Issues in the Recording Industry" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)
	IGELLH79RCNT	"Reply Comments of the National Telecommunications and Information Administration to FCC Docket 20988 and 21284" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)
	IGORDW82FUAM	Fair Use as Market Failure: A Structural and Economic Analysis of the Betamax Case and its Predecessors
	IHOMER84GMSA	"Getting the Message": Statutory Approaches to Electronic Information Delivery and the Duty of Carriage
	ILADDD82SDLR	"Statement of David Ladd, Register of Copyrights and Assistant Librarian of Congress for Copyright Services" in Copyright/Cable Television (Part 1, Serial No. 44)
	ILEVIK82IRAG	Information Resources as "Goods" in the Life Cycle of Information Production
	IMACHF62PADK	The Production and Distribution of Knowledge in the United States
	IMINAJ69PEBI	The Political Economy of Broadcasting in the 1920's
	IPORAM77IEDA	The Information Economy: Definition and Measurement
	IPORAM77IENI	The Information Economy: National Income, Workforce, and Input-Output Accounts
	IPRIEW84ECWP	"Economics of Copyright" (Working Paper)
	ISCHEF77EECP	The Economic Effects of Compulsory Patent Licensing
	ITOULH39PAPI	Patents and the Public Interest
	IUSC*HC79SNB	"Statement of National Broadcasting Company, Inc." in Copyright/Cable Television (Part 1, Serial No. 44)
	IVALEJ79TJVP	"Testimony of Jack Valenti, President, Motion Picture Association

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
MONOPOLY	IPETHR830PAD	On the Production and Distribution of Information
	IPOGUT78GAEC	Government and Economic Choice: An Introduction to Public Finance
	IPRIEW84ECWP	"Economics of Copyright" (Working Paper)
	ISAMUP73ENE*	Economics (Ninth Edition)
	ISILBA71PSIE	"The Patent System" in Economics of Information and Knowledge (edited by D. M. Lamberton)
	ISINGN72PM**	Public Microeconomics
	ITOULH39PAPI	Patents and the Public Interest
	IUSNC*79FRNC	Final Report of the National Commission on New Technological Uses of Copyrighted Works (CONTU Report)
MORAL-RIGHTS	IMCDOD83CCSN	Copyright Can Survive the New Technologies
MOTION-PICTURE-INDUSTRY	IVALEJ79TJVP	"Testimony of Jack Valenti, President, Motion Picture Association of America" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)
MOTIVATION-TO-WORK	IARROK71EWAA	"Economic Welfare and the Allocation of Resources for Invention" in Economics of Information and Knowledge (edited by D. M. Lamberton)
	IDUTTH84PSAI	The Patent System and Inventive Activity during the Industrial Revolution: 1850-1852
	IGASTJ78RSIB	The Reward System in British and American Science
	IREECJ81ITWF	Incentives to Work for Engineers and Scientists
	ITORRG67MAMP	The Motivation and Measurement of Performance
NATIONAL-ACCOUNTS	ICOOPM83SAFI	The Structure and Future of the Information Economy
	IPORAM77IEDA	The Information Economy: Definition and Measurement
	IPORAM77IENI	The Information Economy: National Income, Workforce, and Input-Output Accounts
NATIONAL-INCOME	IPORAM77IENI	The Information Economy: National Income, Workforce, and Input-Output Accounts
NATURAL-LAW	IDUTTH84PSAI	The Patent System and Inventive Activity during the Industrial Revolution: 1850-1852
NCLIS	ICUADC80RPSI	The Role of the Private Sector in the Development and Improvement

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
NON-DEPLETABILITY	ILEVIK82IRAG	Production
	IO'BRR80PEII	The Political Economy of Information in a Changing International Economic Order
	IPRIEW84CIIC	"Characteristics of Information in Commerce and Transactions" (Working Paper)
	IPRIEW84DEGA	"Development of Economic Guidelines and Alternative Options for Public Investment and Disinvestment Decisions in Scientific and Technical Information" (Working Paper)
NON-PECUNIARY	IGASTJ78RSIB	The Reward System in British and American Science
NORDHAUS,-WILLIAM-D.	ISCHEF77EECP	The Economic Effects of Compulsory Patent Licensing
OCCUPATION	IPORAM77IEDA	The Information Economy: Definition and Measurement
	IPORAM77IENI	The Information Economy: National Income, Workforce, and Input-Output Accounts
OLIGOPOLY	IALDEW65PAPT	Patents and Progress: The Sources and Impact of Advancing Technology
	IBACKF68EAIT	Economics: An Introduction to Analysis and Policy
	IKEISN65EAAP	Economics: Analysis and Policy
OPERA	ILEVIF76CB**	The Culture Barons
OPPORTUNISM	ICREWM84RCAE	Royalty Contracts: An Efficient Form of Contracting?
	IO'BRR80PEII	The Political Economy of Information in a Changing International Economic Order
OWNERSHIP-EXTERNALITY	ILEVIK82IRAG	Information Resources as "Goods" in the Life Cycle of Information Production
PAGE-CHARGE	IBRAUY75ERFP	An Economic Rationale for Paga and Submission Charges by Academic Journals
PAINTERS	IHASKF63PAP*	Patrons and Painters
	ILEVIF76CB**	The Culture Barons
PARETO-OPTIMALITY	IBAUMW75OOPG	On the Optimality of Public-Goods Pricing with Exclusion Devices
	IHERBB71MPFT	Modern Public Finance: The Study of Public Sector Economics
	IMACHF84KICD	Knowledge: Its Creation, Distribution, and Economic Significance, Volume III, The Economics of Information and Human Capital

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
PATENT-LICENSING	ICROPJ70TIIT	Trade in Innovation: The Ins and Outs of Licensing
	IGELLE81ALAE	Antitrust Law and Economics: in a Nutshell
PATENT-POOLING	IALDEW65PAPT	Patents and Progress: The Sources and Impact of Advancing Technology
	IBOWMW73PAAL	Patent and Antitrust Law: A Legal and Economic Appraisal
	ITOULH39PAPI	Patents and the Public Interest
PATENT-TAX	ITOULH39PAPI	Patents and the Public Interest
PATRONAGE	IHASKF63PAP*	Patrons and Painters
	ILADDD82SDLR	"Statement of David Ladd, Register of Copyrights and Assistant Librarian of Congress for Copyright Services" in Copyright/Cable Television (Part 1, Serial No. 44)
	ILARSG83RPTU	The Reluctant Patron: The United States Government and the Arts, 1943-1965
	ILEVIF76CB**	The Culture Barons
	IMILLH70DFRS	Dollars for Research: Science and Its Patrons in Nineteenth-Century America
	IREAGM69SAFP	Science and the Federal Patron
	ITEMIC85FFAH	Fundraiser for the Arts Has Key to the Boardrooms
PERFORMANCE-ROYALTY	IDERTJ81SEII	"A Study of Economic Issues in the Recording Industry" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)
PERFORMING-RIGHTS	IECOCC71ROIA	Report on Intellectual and Industrial Property
PHILANTHROPY	IGOULJ71MGAE	The Money Givers: An Examination of the Myths and Realities of Foundation Philanthropy in America
	IMILLH70DFRS	Dollars for Research: Science and Its Patrons in Nineteenth-Century America
	INIELW72BF**	The Big Foundations
PIRACY	IFRAZD85PS5S	Piracy Study: 50% of Software Copied Illegally
	IPCW**85NSBI	Nipping the Software Buccaneers in the Bud
POLICY	IBACKF68EAIT	Economics: An Introduction to Analysis and Policy

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
POLITICAL-ECONOMY	IMACKE82EIAL	Economics of Information and Law
	IMINAJ69PEBI	The Political Economy of Broadcasting in the 1920's
	INORDW69IGAW	Invention, Growth, and Welfare: A Theoretical Treatment of Technological Change
	IPRIEW84PEPW	"Political Economics of Property" (Working Paper)
	ISANDT78PEPG	The Political Economy of Public Goods and International Cooperation
	ISCHWA80PAEP	Property and Economic Power
	ITHOMS82FCEC	Film/Culture: Explorations of Cinema in its Social Context
	ITOULH39PAPI	Patents and the Public Interest
PORAT,-URI	ICOOPM83SAFI	The Structure and Future of the Information Economy
POSNER,-RICHARD-A.	IBESES78CLFC	Copyright Liability for Cable Television: Compulsory Licensing and the Coase Theorem
PREDATORY-PRICING	IBRAUY81FIMI	"The Functioning of Information Markets" in Issues in Information Policy (directed by Jane H. Yurow, edited by Helen A. Shaw)
PREFERENCE-INDICATORS	IHINDA76EIIA	"The Economics of Information" in Annual Review of Information Science and Technology
PRICE DISCRIMINATION	ICOOPM83EIIA	"The Economics of Information" in Annual Review of Information Science and Technology
PRICE-DISCRIMINATION	IBAUMW75OOPG	On the Optimality of Public-Goods Pricing with Exclusion Devices
	IBESES78CLFC	Copyright Liability for Cable Television: Compulsory Licensing and the Coase Theorem
	IBRAUY81FIMI	"The Functioning of Information Markets" in Issues in Information Policy (directed by Jane H. Yurow, edited by Helen A. Shaw)
	IDERTJ81SEII	"A Study of Economic Issues in the Recording Industry" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)
	IHALLK81ENI*	The Economic Nature of Information
	IMCDOD83CCSN	Copyright Can Survive the New Technologies
PRIMARY-ACTIVITIES	ICUADC80RPSI	The Role of the Private Sector in the Development and Improvement of Library and Information Services

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The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
PROPERTY-RIGHT	ILEVIK82IRAG	Information Resources as "Goods" in the Life Cycle of Information Production
	IMACKE82EIAL	Economics of Information and Law
	IPEYTD81CIPR	"The Creation of Information: Property Rights and Subsidies" in Issues in Information Policy (directed by Jane Yurow, edited by Helen A. Shaw)
	IPOGUT78GAEC	Government and Economic Choice: An Introduction to Public Finance
	IPRIEW84PEPW	"Political Economics of Property" (Working Paper)
	ISCHWA80PAEP	Property and Economic Power
PROPERTY-STRUCTURES	ICROSM81ATHT	A. T. Hadley: The American Invention of the Economics of Property Rights and Public Goods
PROPERTY-VALUE-OF-PATENT	ICROPJ70TIIT	Trade in Innovation: The Ins and Outs of Licensing
PUBLIC-BROADCASTING	IGOLDH69FPB*	Financing Public Broadcasting
PUBLIC-FINANCE	IKEISN65EAAP	Economics: Analysis and Policy
	IPOGUT78GAEC	Government and Economic Choice: An Introduction to Public Finance
	ISINGN72PM**	Public Microeconomics
PUBLIC-GOOD	IBESES78CLFC	Copyright Liability for Cable Television: Compulsory Licensing and the Coase Theorem
	IBRAUY76IAAC	Information as a Commodity
	IBRAUY81FIMI	"The Functioning of Information Markets" in Issues in Information Policy (directed by Jane H. Yurow, edited by Helen A. Shaw)
	IBRAUY81IAAC	"Information as a Commodity: Public Policy Issues and Recent Research" in Information Services: Economics, Management, and Technology (edited by Robert M. Mason and John E. Creps, Jr.)
	ICOOPM83EIIA	"The Economics of Information" in Annual Review of Information Science and Technology
	ICROSM81ATHT	A. T. Hadley: The American Invention of the Economics of Property Rights and Public Goods
	IFLOWA81GSRI	"The Government's Role in Providing Information: A British Academic's View" in Information Services: Economics, Management, and Technology (edited by Robert M. Mason and John E. Creps, Jr.)

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
PUBLIC/PRIVATE	IPRIEW84DEGA	"Development of Economic Guidelines and Alternative Options for Public Investment and Disinvestment Decisions in Scientific and Technical Information" (Working Paper)
	IUSLC*84PPSI	Public/Private Sector Interactions: The Implications for Networking
PUBLISHER'S-FIXED-FEE	ICREWM84RCAE	Royalty Contracts: An Efficient Form of Contracting?
PUBLISHING	ICREWM84RCAE	Royalty Contracts: An Efficient Form of Contracting?
	ILARSE84ICSB	Interactive Computer Services Become New Literary Medium
R&D	IMANTA83IPAS	Information Policy and Scientific Research
	INATAS69SATC	Scientific and Technical Communication: A Pressing National Problem and Recommendations for Its Solution (Committee on Scientific and Technical Communication)
	INORDW85PDWW	"Private Discussion with William D. Nordhaus"
	IPRIEW84DEGA	"Development of Economic Guidelines and Alternative Options for Public Investment and Disinvestment Decisions in Scientific and Technical Information" (Working Paper)
	IREAGM69SAFP	Science and the Federal Patron
	ISCHEF77EECP	The Economic Effects of Compulsory Patent Licensing
	ISLITR71TTRA	"The Tax Treatment of Research and Innovative Investment" in Economics of Information and Knowledge (edited by D. M. Lamberton)
REAL-PROPERTY-RIGHT	IPEYTD81CIPR	"The Creation of Information: Property Rights and Subsidies" in Issues in Information Policy (directed by Jane Yurow, edited by Helen A. Shaw)
RECORD-CLUB	IDERTJ81SEII	"A Study of Economic Issues in the Recording Industry" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)
RECORDING-INDUSTRY	IDERTJ81SEII	"A Study of Economic Issues in the Recording Industry" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)
REDUCTION-OF-CONCENTRATION	IECOCC71ROIA	Report on Intellectual and Industrial Property
REGULATION	IFEINS81RSIA	"Regulation of STI Industry: A Historical Basis and Some Possibilities" in Information Services: Economics, Management, and Technology (edited by Robert M. Mason and John E. Creps, Jr.)
	IFLOWA81GSRI	"The Government's Role in Providing Information: A British Academic's

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The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
ROYALTY	IMCDOD83CCSN	Copyright Can Survive the New Technologies
	IMEYEH66SPHA	"Statement of Prof. Howard A. Meyerhoff, Director and President, Committee to Investigate Copyright Problems Affecting Communication in Science and Education" in Copyright Law Revision (Part 3, Serial No. 8)
	IPOOLI80IPAT	Intellectual Property and Transborder Data Flows
	ITAYLC73EIPS	The Economic Impact of the Patent System
	IUSC*HC79SNB	"Statement of National Broadcasting Company, Inc." in Copyright/Cable Television (Part 1, Serial No. 44)
	IVALEJ79TJVP	"Testimony of Jack Valenti, President, Motion Picture Association of America" in Copyright Issues: Cable Television and Performance Rights (Serial No. 28)
ROYALTY-NONTRANSACTION-TIED	IMCDOD83CCSN	Copyright Can Survive the New Technologies
ROYALTY-POOL	IPOOLI80IPAT	Intellectual Property and Transborder Data Flows
ROYALTY-TRANSACTION-TIED	IMCDOD83CCSN	Copyright Can Survive the New Technologies
S&T-INFORMATION	IALDRR81IIIP	Issues in Information Policy
	IBAUMW75OOPG	On the Optimality of Public-Goods Pricing with Exclusion Devices
	IBAUMW76PFIT	Private Financing of Information-Transfer - Theory and Execution
	IBAUMW80MPAC	Manual of Pricing and Cost Determination for Organizations Engaged in Dissemination of Knowledge
	IBRANL83IRDP	Improving R&D Productivity: The Federal Role
	IBRAUY75ERFP	An Economic Rationale for Page and Submission Charges by Academic Journals
	IBRAUY76IAAC	Information as a Commodity
	IBRAUY76PPAR	Public-Policy and Research on Economics in Information-Transfer
	IBRAUY79CABL	Costs and Benefits of Library Information: The User Point of View
	ICHARR83IPPL	Information Policy: Public Laws from the 97th Congress
	ICLEVH82IAAR	Information as a Resource
	ICOOPM83EIIA	"The Economics of Information" in Annual Review of Information Science and Technology

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KEYWORD	IDENTITY	TITLE
S&T-INFORMATION	IUSOMA83OCA7	OMB Circular A-76
	IVINKP82IEGA	Information Economy, Government and Society
SCIENCE-RESEARCH	IGASTJ78RSIB	The Reward System in British and American Science
	IMANTA83IPAS	Information Policy and Scientific Research
	INATAS69SATC	Scientific and Technical Communication: A Pressing National Problem and Recommendations for Its Solution (Committee on Scientific and Technical Communication)
SEARCH	ICOOPM83EIIA	"The Economics of Information" in Annual Review of Information Science and Technology
	IKWONY82PVPP	Private versus Public Production of Information
	IMACKE82EIAL	Economics of Information and Law
	ISTIGG71EIIE	"The Economics of Information" in Economics of Information and Knowledge (edited by D. M. Lamberton)
SECOND-BEST	IMACKE82EIAL	Economics of Information and Law
SECONDARY-SECTOR	IPORAM77IEDA	The Information Economy: Definition and Measurement
	IPORAM77IENI	The Information Economy: National Income, Workforce, and Input-Output Accounts
SHAREABILITY	ICLEVH82IAAR	Information as a Resource
SMALL-FIRM	ITOULH39PAPI	Patents and the Public Interest
SOCIAL-RATE-OF-RETURN	INORDW85PDWW	"Private Discussion with William D. Nordhaus"
SOCIAL-RATES-OF-RETURN	IMANSE77SAPR	Social and Private Rates of Return from Industrial Innovations
SOFTWARE	IFRAZD85PS5S	Piracy Study: 50% of Software Copied Illegally
	IPCW**85NSBI	Nipping the Software Buccaneers in the Bud
STIMULATE-INNOVATION	IBRAUY81FIMI	"The Functioning of Information Markets" in Issues in Information Policy (directed by Jane H. Yurow, edited by Helen A. Shaw)
	ISCHEF77EECP	The Economic Effects of Compulsory Patent Licensing
	ISCHMJ66IAEG	Invention and Economic Growth
	ITAYLC73EIPS	The Economic Impact of the Patent System

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The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
SUPPORT-BY-TAX	IFEINS81RSIA	Information Services: Economics, Management, and Technology (edited by Robert M. Mason and John E. Creps, Jr.)
	IFLOWA81GSRI	"The Government's Role in Providing Information: A British Academic's View" in Information Services: Economics, Management, and Technology (edited by Robert M. Mason and John E. Creps, Jr.)
	IGOLDH69FPB*	Financing Public Broadcasting
	IGORDW82FUAM	Fair Use as Market Failure: A Structural and Economic Analysis of the Betamax Case and its Predecessors
	IPETHR83OPAD	On the Production and Distribution of Information
	IPEYTD81CIPR	"The Creation of Information: Property Rights and Subsidies" in Issues in Information Policy (directed by Jane Yurow, edited by Helen A. Shaw)
	IPOGUT78GAEC	Government and Economic Choice: An Introduction to Public Finance
	ISLITR71TTRA	"The Tax Treatment of Research and Innovative Investment" in Economics of Information and Knowledge (edited by D. M. Lamberton)
SYNDICATED-PROGRAMS	IVALEJ82PTCF	"A Plea to the Congress for Equity: The Case for Fair and Open Competition in the Cable Television Marketplace, Instead of the Anti-Competitive Arena that Exists Today" in Copyright/Cable Television (Part 1, Serial No. 44)
TAYLOR-AND-SILBERSTON	ISCHEF77EECP	The Economic Effects of Compulsory Patent Licensing
TECHNICAL-STANDARDS	IBRAUY81FIMI	"The Functioning of Information Markets" in Issues in Information Policy (directed by Jane H. Yurow, edited by Helen A. Shaw)
THEATER	ILEVIF76CB**	The Culture Barons
TIME-LIMITED-CONSUMPTION	IPRIEW84CIIC	"Characteristics of Information in Commerce and Transactions" (Working Paper)
TRADE	IPORAM77IENI	The Information Economy: National Income, Workforce, and Input-Output Accounts
TRADE-SECRET	IADLER84BAAI	Biotechnology as an Intellectual Property
	IGILBM82IPRI	Intellectual Property Rights in High Technology Products and in Sensitive Business Information
	IPEYTD81CIPR	"The Creation of Information: Property Rights and Subsidies" in Issues in Information Policy (directed by Jane Yurow, edited by Helen A. Shaw)
TRADEMARK	IADLER84BAAI	Biotechnology as an Intellectual Property

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
USER-FEE	IBESES78CLFC	and the Coase Theorem
	IBRANL83IRDP	Improving R&D Productivity: The Federal Role
	IBRAUY75ERFP	An Economic Rationale for Page and Submission Charges by Academic Journals
	IBRAUY81FIMI	"The Functioning of Information Markets" in Issues in Information Policy (directed by Jane H. Yurow, edited by Helen A. Shaw)
	ICOOPM83EIIA	"The Economics of Information" in Annual Review of Information Science and Technology
	IGOLDH69FPB*	Financing Public Broadcasting
	IHINDA76EIIA	"The Economics of Information" in Annual Review of Information Science and Technology
	IPOGUT78GAEC	Government and Economic Choice: An Introduction to Public Finance
	IUSOMA83OCA7	OMB Circular A-76
USNFAH	ILARSG83RPTU	The Reluctant Patron: The United States Government and the Arts, 1943-1965
USNSF	IREAGM69SAFP	Science and the Federal Patron
USOMB-A-76	IBRAUY81FIMI	"The Functioning of Information Markets" in Issues in Information Policy (directed by Jane H. Yurow, edited by Helen A. Shaw)
	ICUADC80RPSI	The Role of the Private Sector in the Development and Improvement of Library and Information Services
	INATCO82PSPS	Public Sector / Private Sector Interaction in Providing Information Services
	IPEYTD81CIPR	"The Creation of Information: Property Rights and Subsidies" in Issues in Information Policy (directed by Jane Yurow, edited by Helen A. Shaw)
	IUSOMA83OCA7	OMB Circular A-76
VALUATION	IPRIEW82VHDI	"Valuing Human Disease, Injury and Death" in Analyzing the Benefits of Health, Safety, and Environmental Regulations
VALUE-ADDED	IBRANL83IRDP	Improving R&D Productivity: The Federal Role
	ICUADC80RPSI	The Role of the Private Sector in the Development and Improvement of Library and Information Services
	IGRIFJ82VIAR	"The Value of Information and Related Systems, Products, and Services"

PUBLISHER'S NOTE:

The Following Pages Were Unavailable for Filming:

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KEYWORD	IDENTITY	TITLE
WILLINGNESS-TO-PAY	ICOOPM83EIIA	Science and Technology
	IGORDW82FUAM	Fair Use as Market Failure: A Structural and Economic Analysis of the Betamax Case and its Predecessors
	IHINDA76EIIA	"The Economics of Information" in Annual Review of Information Science and Technology
	IPETHR83OPAD	On the Production and Distribution of Information